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POLLUTION OF THE INTERSTATE WATERS OF THE LOWER MISSISSIPPI RIVER. PROCEEDINGS OF CONFERENCE HELD AT NEW ORLEANS, LOUISIANA ON MAY 5-6, 1964. VOLUME I

Public Health Service
Washington, D. C.

6 May 1964

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CONFERENCE

in the matter of

Pollution of the Interstate Waters of the

LOWER MISSISSIPPI RIVER

PROCEEDINGS

Volume I

May 5-6, 1964
New Orleans, Louisiana

U.S. Department of Health, Education, and Welfare
Washington, D.C.

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Conference in the Matter of Pollution of the Interstate Waters of the Lower Mississippi River (Arkansas-Tennessee-Mississippi-Louisiana) convened at 9:30 a.m., on Tuesday, May 5, 1964, in Room T-13028, Federal Office Building, 701 Loyola Avenue, New Orleans, Louisiana.

PRESIDING:

Mr. Murray Stein, Chief, Enforcement Branch, Water Supply and Pollution Control, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C.

CONFEREES:

Mr. Marvin Wood, Director, Water Pollution Control Commission, Arkansas

Mr. Edward A. Albares, Chairman, Water Pollution Control Commission, Arkansas

Mr. Richard N. Deed, Vice Chairman, Water Pollution Control Commission, Arkansas

Mr. Jerome Svore, Regional Program Director, Water Supply and Pollution Control, Public Health Service, Department of Health, Education, and Welfare, Region VII, Dallas, Texas

CONFEREES (Continued):

Mr. S. Leary Jones, Executive Secretary, Tennessee Stream Pollution Control Board, Nashville, Tennessee

Mr. J. E. Johnston, Director, Sanitary Engineering, Mississippi State Board of Health, Jackson, Mississippi

Mr. Robert Lafleur, Executive Secretary, Louisiana Stream Control Commission

Mr. John E. Trygg, State Sanitary Engineer, State Board of Health, New Orleans, Louisiana

PARTICIPANTS:

Mr. K. E. Biglane, Chief for Eastern Operations, Water Projects Section, Technical Services Branch, Public Health Service, Washington, D. C.

Dr. Clarence M. Tarzwell, Chief of the Aquatic Biology Section, Basic and Applied Sciences Branch, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

PARTICIPANTS (Continued):

Dr. Donald Mount, Fisheries Research Biologist, Basic and Applied Sciences Branch, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Dr. Mary Schaefer, Research Chemist, Food Chemistry, Milk and Food Research, Division of Environmental Engineering and Food Protection, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Dr. Andrew W. Breidenbach, Chief, Technical Operations, and Acting Chief, Organic Chemistry Laboratory, Basic Data Branch, Water Pollution Surveillance System, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Dr. Alfred R. Grzenda, Assistant Chief, Pesticide Pollution Studies, United States Public Health Service, Atlanta, Georgia

Mr. Frank W. Kittrell, Chief, Pollution Evaluation Section, Technical Services Branch, United States Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

PARTICIPANTS (Continued):

Mr. Keith S. Krause, Chief, Technical Services Branch, United States Public Health Service, Washington, D. C.

Mr. Edwin C. Boudreaux, Director, New Orleans District, Food and Drug Administration, United States Department of Health, Education, and Welfare

Mr. Robert J. Anderson, Deputy Administrator, Agricultural Research Service, United States Department of Agriculture, Washington, D. C.

Dr. R. E. Johnson, Assistant Director, Bureau of Sport Fisheries and Wildlife, United States Department of the Interior, Washington, D. C.

Mr. Jack Lowe, Bureau of Commercial Fisheries, United States Department of the Interior, Florida

Dr. Fred P. Meyer, Parasitologist, Fish Farming Experimental Station, Stuttgart, Arkansas

Mr. John M. Stubbs, Supervisor of Pollution Control and Warm Water Streams for the Tennessee Stream Commission

.Mr. Eugene H. Holeman, State Chemist and Food and Drug Director of the Tennessee Department of Agriculture, Nashville, Tennessee

PARTICIPANTS (Continued):

Mr. Bernard Lorant, Vice President, Research, Velsicol Chemical Corporation, Chicago, Illinois

Mr. Grover C. Dowell, University of Arkansas Extension Entomologist, P. O. Box 391, Little Rock, Arkansas

Mr. Sumner H. McAllister, General Manager, Agricultural Chemicals Division, Shell Chemical Company

Dr. Walter K. Porter, Jr., Superintendent of the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi

Dr. Denzel E. Ferguson, Department of Zoology, Mississippi State University

Dr. Lyle S. St. Amant, Chief, Seafood Division, Louisiana Wild Life and Fisheries Commission

Mr. Richard Carlton, State Entomologist, Louisiana Department of Agriculture

Dr. L. D. Newsom, Head of the Department of Entomology, Louisiana State University

Mr. Lloyd L. Lauden, Agronomist and Field Representative, American Sugar Cane League of the U.S.A., Inc.

OTHERS IN ATTENDANCE:

Mr. Frank J. Coogan, Southern Kraft Division, International Paper Company, Drawer A, Mobile, Alabama

Mr. L. W. Roznoy, Olin Chemical Corporation, 745 - Fifth Avenue, New York City

Mr. Bud Swift, Biologist, Little Rock, Arkansas

Mr. Frank Rainwater, Public Health Service, Department of Health, Education, and Welfare, Washington, D. C.

Mr. A. F. Gimble, Inspector, Pesticides Regulation Division, United States Department of Agriculture, P. O. Box 19473, New Orleans, Louisiana

Mr. Ray Skrmetta, President, Deepsouth Packing Company, Inc., 3536 Lowerline Street, New Orleans, Louisiana

Mr. Charles M. Carriere, Vice President, Southern Shell Fish Company, Inc., New Orleans, Louisiana

Mr. Richard K. Yancey, Assistant Director, Louisiana Wild Life and Fisheries Commission, 400 Royal Street, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. Billy Free, Arkansas Pollution Control Commission, Dumas, Arkansas

Mr. Ewing W. Kinkead, Arkansas Pollution Control Commission, State Capitol, Little Rock, Arkansas

Mr. Donald Lee, Louisiana State University, Box 20163, Baton Rouge, Louisiana

Mr. William E. Towell, Director, Missouri Conservation Commission, Jefferson City, Missouri

Mr. George Pappas, Chemical Engineer, Shilstone Testing Laboratories, Inc., New Orleans, Louisiana

Mr. Richard F. Heuermann, Chief Chemist, United States Food and Drug Administration, 222 Custom House, New Orleans, Louisiana

Mr. W. V. Robertson, Past President, Mississippi Wildlife Federation, P. O. Box 296, Gulfport, Mississippi

Mr. W. T. Shannon, Director, Department of Fish and Game, 722 Capital Mall, Sacramento, California

Dr. Lloyd A. Selby, Tulane University, 1430 Tulane Avenue, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. B. W. Dickerson, Senior Sanitary Engineer, Hercules Powder Company, 910 Market Street, Wilmington, Delaware

Mr. Emil E. Christofano, Industrial Hygienist, Hercules Powder Company, Wilmington, Delaware

Mr. John R. Richards, Public Relations Manager, Shell Oil Company, P. O. Box 60193, New Orleans, Louisiana

Mr. C. H. Pointcaux, Shell Chemical Company, Norco, Louisiana

Mr. J. R. Heard, Manager of Technical Services, Wyandotte Chemicals Corporation, Geismar, Louisiana

Mr. Henri Wolbratte, Executive Vice President, Louisiana Chemical Association, 617 Carendelet Building, New Orleans, Louisiana

Mr. I. J. Becnel, Director of Agricultural Research, Freeport Sulphur Company, 1600 Commerce Building, New Orleans, Louisiana

Mr. R. Z. Finchum, Texas Parks and Wildlife, 1301 - 17th Street, Galveston, Texas

Mr . P. Bearden, Manager, Disposal Well Services, Dow Industrial, Midland, Michigan

OTHERS IN ATTENDANCE (Continued):

Mr. D. P. Walsh, Attorney, Shell Chemical Company, 50 W. 50th Street, New York 20, New York

Mr. John Nutt, Plant Engineer, Kaiser Aluminum and Chemical Company, Box 337, Gramercy, Louisiana

Mr. John H. Hunton, Jr., Manager, Technical Department, American Cyanamid Company, P. O. Box 10008, Jefferson Branch Court, New Orleans, Louisiana

Mr. Jack T. Garrett, Manager, Pollution Abatement, Monsanto Chemical Company, 800 No. Lindbergh Boulevard, St. Louis 66, Missouri

Mr. B. H. Sellers, General Manager, Thompson Hayward Chemical Company, 7700 Earhart Boulevard, New Orleans, Louisiana

Mr. Ralph E. Glasser, General Manager, Shell Chemical Company, 110 W. 57th Street, New York 20, New York

Mr. James W. Selby, Jr., Shell Chemical Company, 119 So. Claiborne, New Orleans, Louisiana

Mr. J. F. White, District Manager, Shell Chemical Company, 555 Tower Building, Little Rock, Arkansas

OTHERS IN ATTENDANCE (Continued):

Mr. R. M. Holaday, Technical Representative, Shell Chemical Company, 1197 Claiborne, New Orleans, Louisiana

Mr. C. C. Dunn, Manager, Pesticide Control Services, Hercules Powder Company, 910 Market Street, Wilmington, Delaware

Mr. Rex Paul, Hercules Powder Company, 216 Rode Center, Greenville, Mississippi

Mr. R. F. Rocheleau, Waste Consultant, Engineering Department, E. I. duPont, Wilmington 98, Delaware

Mr. Roger B. Boren, Shell Development Company, Arcade Building, Greenville, Mississippi

Mr. John B. Coleman, Jr., E. I. duPont, 5125 Norich, Memphis 17, Tennessee

Mr. Hugh W. Black, Superintendent of Technical Service, California Chemical Company, Belle Chasse, Louisiana

Mr. George E. Best, Chemical Engineer, Manufacturing Chemists Association, Inc., 1825 Connecticut Avenue, N. W., Washington, D. C.

Mr. Joseph A. Noone, Technical Director, National Agricultural Chemists Association, 1145 19th Street, N.W., Washington 36, D. C.

OTHERS IN ATTENDANCE (Continued):

Mr. J. M. Moter, Jr., District Engineer, Superior Oil Company, P. O. Box 1516, Lafayette, Louisiana

Mr. L. F. Bewick, Development Coordinator, Velsicol Chemical Corporation, 2118 Valencia Avenue, Monroe, Louisiana

Mr. Louis A. McLean, Secretary, Velsicol Chemical Corporation, 341 E. Ohio Street, Chicago, Illinois

Mr. Curtis F. Hockett, Public Relations Manager Velsicol Chemical Corporation, 341 E. Ohio Street, Chicago, Illinois

Mr. Robert Z. Torrance, Salesman, duPont Company, 9966 E. Tampa Drive, Baton Rouge, Louisiana

Mr. K. T. Karabatsos, Director, Government Relations, Velsicol Chemical Corporation, 1725 K Street, N. W., Washington, D. C.

Mr. H. R. Amberg, Manager, Chemical and Biological Research, Crown Zellerbach Corporation, Camas, Washington

Mr. W. E. Parkinson, Resident Manager, Crown Zellerbach Corporation, P. O. Box 218, St. Francisville, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. Robert E. Branch, Vice President, Chapman Chemical Company, 416 Brooks Road, Memphis 9, Tennessee

Mr. J. Floyd Byrd, Pollution Control Engineer, Procter and Gamble, Ivorydale Technical Center, Cincinnati 17, Ohio

Mr. G. E. Balch, Technical Supervisor, Allied Chemical Corporation, 40 Rector Street, New York 6, New York

Mr. James E. Matush, Laboratory Supervisor, duPont Company, Box 2000, La Place, Louisiana

Mr. Jim Becton, Geigy Agricultural Chemical, 250 Pauline, Greenville, Mississippi

Mr. V. Q. Sibille, Civil Engineer, The Superior Oil Company, P. O. Box 1516 O.C.S., Lafayette, Louisiana

Mr. George D. McKain, Technical Service Engineer, Kaiser Aluminum and Chemical Company, Gramercy, Louisiana

Mr. Jorge E. Burguet, Chemist, Mississippi Power and Light Company, Box 1640, Jackson, Mississippi

OTHERS IN ATTENDANCE (Continued):

Dr. Mitchell R. Zazon, Consultant, Shell Chemical Company, 6268 Sturdy Avenue, Cincinnati, Ohio

Mr. Ben S. Graves, Shell Oil Company, Norco, Louisiana

Mr. D. M. DeVries, Chemist, Shell Development Company, P. O. Box 3011, Modesto, California

Mr. L. E. Mitchell, Shell Chemical Company, 110 W. 51st Street, New York, New York

Mr. George D. Hopkins, Superintendent of Water Purification, STWB, 8501 Spruce Street, New Orleans 18, Louisiana

Mr. Crawford J. Powell, Assistant Superintendent, Sewerage and Water Board, 1300 Perdido Street, New Orleans, Louisiana

Mr. Ford S. Lacey, Executive Vice President, Lamsower Manufacturers Association, 640 Commerce Building, Baton Rouge, Louisiana

Mr. E. F. Hughes, General Superintendent, Sewerage and Water Board, 1300 Perdido Street, New Orleans, Louisiana

Mr. William L. Klein, Ohio River Valley Water Sanitation Commission, 414 Walnut Street, Cincinnati 2, Ohio

OTHERS IN ATTENDANCE (Continued):

Mr. C. R. Walbridge, Industrial Relations, Allied Chemical Corporation, P. O. Box 70, Morristown, New Jersey

Mr. Denver T. Loupe, Louisiana Agricultural Extension Service, Louisiana State University, Baton Rouge, Louisiana

Mr. J. M. Fairall, Chemical Engineering Consultant, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Mr. Thomas Robinson, Superintendent, Vicksburg Water and Gas Administration, Vicksburg City Hall, Vicksburg, Mississippi

Mrs. Iris Day, State Board of Health, 325 Loyola Avenue, New Orleans 16, Louisiana

Dr. F. L. Lyman, Director, Industrial Medicine, Coagy Chemical Corporation, Aroslei, New York

Mr. R. C. Derrick, Plant Engineer, duPont Company, Memphis, Tennessee

Mr. E. A. Cancienne, Louisiana State University Agricultural Extension Service, Knapp Hall, Louisiana State University, Baton Rouge, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. B. Rotman, News Editor, WDSU-TV, 520 Royal, New Orleans, Louisiana

Mrs. Burnette Y. Hennington, Water Pollution Control Advisory Board, 4213 North State Street, Jackson, Mississippi

Mr. E. A. Epps, Jr., Chief Chemist, Louisiana Department of Agriculture, Baton Rouge, Louisiana

Mr. Don Lerch, Lerch and Company, Inc., 1025 Connecticut Avenue, N.W., Washington, D.C.

Mr. John R. Thoman, United States Public Health Service, Division of Water Supply and Pollution Control, Atlanta, Georgia

Mr. John I. Teasley, Chemist, Pesticide Pollution Project, Atlanta, Georgia, United States Public Health Service

Mr. S. Steve Carnegie, Carnegie and Smith, Consulting Engineers, 3000A Dalrymple Drive, Baton Rouge, Louisiana

Mr. A. D. Dacus, Field Director of Research, Thompson-Hayward Chemical Company, 7700 Earhart Boulevard, New Orleans, Louisiana

Mr. Paul Atkinson, Reporter, Times Picayune, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. A. B. Ritter, Assistant Director, Engineering Division, Louisiana State Board of Health, P. O. Box 60630, New Orleans, Louisiana

Dr. Joseph C. Barbaccia (MD), Tulane University School of Medicine, 1430 Tulane Avenue, New Orleans, Louisiana

Mr. J. C. Wendland, Director, Industrial Division, Chamber of Commerce, 315 Camp Street, New Orleans, Louisiana

Mr. Paul Kalman, President, Kalman, Rogers and Smith, Inc., 907 First National Life Building, New Orleans 13, Louisiana

Mr. A. J. Cuccia, Jr., Vice President, SEC, Cutcher Canning Company, Inc., 120 Sala Avenue, Westwego, Louisiana

Mr. L. D. Guion, Commissioner, City of Vicksburg, Vicksburg, Mississippi

Mr. W. J. Cutbirth, Jr., Texas Parks and Wildlife, Regan Building, Austin, Texas

Mr. William J. Allen, Field Representative, Wildlife Management Institute, P. O. Box 1143, Hot Springs, Arkansas

OTHERS IN ATTENDANCE (Continued):

Mr. Leslie L. Glasgow, Professor, Wildlife Management, Louisiana State University School of Forestry and Wildlife Management, Baton Rouge, Louisiana

Mr. Harold C. Taylor, Water Supply and Pollution Control, Public Health Service, Region IV, 50 - Seventh Street, N.E., Atlanta, Georgia

Mr. V. O. Calandro, County Agricultural Agent, Louisiana State University Extension Service, Edgard, Louisiana

Mr. T. H. Shepart, Jr., President, Louisiana Shrimp Association, 312 Cigali Building, New Orleans 30, Louisiana

Mr. Walter K. Ponten, Jr., Superintendent, Delta Branch Experiment Station, Stoneville, Mississippi

Mr. George W. Snow, Regional Supervisor, Staff and Market News, Bureau of Commercial Fisheries, 609-11 Federal Building, New Orleans, Louisiana

Mr. H. Spiegelblatt, Administrative Assistant, Chicago Board of Health, 54 W. Hubbard Street, Chicago, Illinois

OTHERS IN ATTENDANCE (Continued):

Mr. James S. Ward, Special Assistant to Under Secretary, United States Department of Agriculture, Washington, D. C.

Mr. Herbert F. Berger, Regional Engineer, National Council for Stream Improvement, P. O. Box 1M, Baton Rouge, Louisiana

Dr. T. C. S. Paterson, Director, Division of Hygiene and Tropical Medicine, Tulane University, 1430 Tulane Avenue, New Orleans, Louisiana

Mr. W. E. Shell, Jr., Biologist, United States Army Engineer District, N. O., Foot of Prytonia Street, New Orleans, Louisiana

Mr. C. C. Fancher, Agricultural Research Service, United States Department of Agriculture, P. O. Box 989, Gulfport, Mississippi

Mr. William F. Barthel, Chemist, United States Department of Agriculture, 22-52nd Street, Gulfport, Mississippi

Mr. Herbert E. Mills, Sr., Regional Dealer, Everpure, Inc., 822 1/2 Baronne Street, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. C. C. Youngs, President, Jefferson Parish Farm Bureau, 208 Moss Lane, Westwego, Louisiana

Mr. Henning Eklund, Senior Sanitary Engineer, Region V, Public Health Service, Department of Health, Education, and Welfare, 433 W. Van Buren Street, Chicago 7, Illinois

Mr. Robert I. Livingston, Assistant City Attorney, 300 Memphis Bank Building, Memphis, Tennessee

Mrs. W. A. Zimmermann, League of Women Voters, Member, 5134 Press Drive, New Orleans, Louisiana

Mr. Joseph M. Jurisich, President, P.S.J. Oyster Company, 1039 Toulouse Street, New Orleans, Louisiana

Mr. Charles B. Kaiser, Jr., General Counsel, Metropolitan St. Louis Sewer District, 2000 Hampton Avenue, St. Louis 39, Missouri

Mrs. Mary Kell, Press, Fairchild Publications, 735 Dumdine Street, New Orleans, Louisiana

Mr. Harry Schafer, Supervisor, Fisheries Section, Louisiana Wild Life and Fisheries Commission, 400 Royal Street, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. Peter F. Mattei, Executive Director, Metropolitan St. Louis Sewer District, 200 Hampton Avenue, St. Louis 39, Missouri

Mr. J. F. Bowman, Southern Shell Fish Company, Inc., Box 97, Harvey, Louisiana

Mr. James Summersgill, Golden Meadow Ice Company, Golden Meadow, Louisiana

Mr. Marcus Rosenblum, Public Health Service, Washington, D. C.

Mr. David M. Goodrich, Assistant Director, Tennessee Game and Fish Commission, Cordell Hull Building, Nashville, Tennessee

Mr. Fred Hammond, News Director, WWL-CBS, New Orleans, Louisiana

Mrs. Julian W. Low, League of Women Voters, 4230 Drewy Avenue, New Orleans, Louisiana

Mr. Leo W. Hough, State Biologist, Louisiana Department of Conservation, Stream Control Commission, Baton Rouge, Louisiana

Mr. J. K. Dowsy, 2266 E. Contour Drive, Baton Rouge, Louisiana

Mr. Jack K. Smith, Executive Secretary, Missouri Water Pollution Board, P. O. Box 154, Jefferson City, Missouri

OTHERS IN ATTENDANCE (Continued):

Mr. Harry H. Hilliker, Missouri Water Pollution Board, 3463 Longfellow Boulevard, St. Louis, Missouri

Mr. C. M. Davis, President, Jefferson Davis Farm Bureau, R. I. Box 10, Jennings, Louisiana

Mr. William I. Fishheim, Chief Epidemiologist, Chicago Board of Health, 54 W. Hubbard Street, Chicago, Illinois

Mr. M. J. Foster, 609 Adams Street, Franklin, Louisiana

Mr. Harold Junea, President, Cypremort Farms, Inc., Louisa P. O., Louisa, Louisiana

Mr. Bruce Greek, Bureau Head, Chemical and Engineering News 1121 Walker Avenue, Houston, Texas

Mr. George T. Geiger, Jr., County Agent, Jefferson Parish, Courthouse, Gretna, Louisiana

Mr. Peter J. Brennan, Regional Editor, Chemical Engineering Magazine, 724 Prudential Building, Houston, Texas

Mr. Raymond Galant, Assistant to the Editor, Food Chemical News, 602 Warner Building, Washington, D. C.

OTHERS IN ATTENDANCE (Continued):

Mr. Ed Cocke, Press, United Press International, 520 Royal Street, New Orleans, Louisiana

Mr. L. W. Strasburger, Strasburger Inspection Service, 429 Betz Place, Metairie, Louisiana

Mrs. Lawrence Nelson, Water Resource Chairman, League of Women Voters, 234 Lang Avenue, Long Beach, Mississippi

Mr. William S. Cox, Supervisory Chemist, United States Public Health Service, Region IV, 22 Seventh Street, N.E., Atlanta 8, Georgia

Mr. John Biggs, President's Water Pollution Advisory Board, 600 N. Capital Way, Olympia, Washington

Mr. McFadden Duffy, Information Representative, Louisiana Wild Life and Fisheries Commission, 400 Royal Street, New Orleans, Louisiana

Mr. Vincent D. Patton, Director, Division of Industrial Wastes, Bureau of Sanitary Engineering, Florida State Board of Health, P. O. Box 210, Jacksonville, Florida

Mr. Fernand Falgoust, Jr., President, W. St. James Farm Bureau, Route 2, Box 45, St. James, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. Grover C. Dowell, Extension Entomologist, University of Arkansas, P. O. Box 391, Little Rock, Arkansas

Mr. Ralph B. Dysart, Salesman, S. B. Penick and Company, P. O. Box 10234, Dallas 7, Texas

Mr. George R. Fuller, County Agent, Louisiana State University and Chamber of Commerce, P. O. Box 30240, New Orleans, Louisiana

Mr. William H. Herke, Assistant Leader, Louisiana Cooperative Fishery Unit, Forestry Building, Louisiana State University, Baton Rouge, Louisiana

Mr. R. O. Smitherman, Leader, Louisiana Cooperative Fishery Unit, Room 201 Forestry Building, Baton Rouge, Louisiana

Mr. James M. McHaney, Attorney, Arkansas Water Pollution Control Commission, 921 W. Markham, Little Rock, Arkansas

Mr. Lewis J. Johnson, President, Arkansas Farmers Union, Arkansas Water Pollution Control Commission, 711 No. Monroe Street, Little Rock, Arkansas

Mr. Ben F. Barrentine, Mississippi State University, Box 642, State College, Mississippi

OTHERS IN ATTENDANCE (Continued):

Mr. T. E. Maxson, City Engineer, City of Memphis, 247 Washington Avenue, Memphis, Tennessee

Mr. Stanley F. Kapustka, District Chemist, United States Geological Survey, 6554 Florida Boulevard, Baton Rouge, Louisiana

Mr. S. J. Trombetta, Chief, Water Quality Section, Water Supply and Pollution Control, Region IV, Public Health Service, Department of Health, Education, and Welfare, 50 - Seventh Street, Atlanta, Georgia

Mr. Graham Walton, United States Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Mr. Everett C. Handorf, Chief Sanitary Engineer, Health Department, 814 Jefferson Avenue, Memphis, Tennessee

Dr. Arthur F. Novak, Professor and Head, Department of Food Science and Technology, Louisiana State University, Baton Rouge, Louisiana

Mr. Fred O. Bridges, Sanitary Engineer, United States Public Health Service Hospital, Carville, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. Robert R. DeSpain, Sanitary Engineer, United States Public Health Service Hospital, Carville, Louisiana

Dr. R. C. Jung, Health Director, City of New Orleans, City Hall, New Orleans, Louisiana

Mr. John McPherson, Entomologist, Southern Extension, 1406 Seejur, Met. - La.

Mr. Edward J. Martin, Jr., President, Terminn Service Company, 3509 Toulouse Street, New Orleans, Louisiana

Mr. Pete Fish, U.P.I. Pictures, New Orleans, Louisiana

Mr. John L. Buckley, Office of Science and Technology, Executive Office Building, Washington, D. C.

Mr. Leo W. Spath, Director, Food and Drug Division, Louisiana State Board of Health, P. O. Box 60630, State Office Building, New Orleans, Louisiana

Mr. Rod Harris, News Editor, WVUE-TV, 1418 Cleveland Street, New Orleans, Louisiana

Mr. Nick L. Skansi, Route 1, Box 67, Port Sulphur, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. E. J. Guidry, Manager, Terre Haute Plantation, P. O. Box 385, Reserve, Louisiana

Mr. Dalton E. Gandy, Cotton Production Specialist, National Cottonseed Products Association, P. O. Box 286, Ruston, Louisiana

Mr. Louis Milliner, Associated Press, New Orleans, Louisiana

Mr. A. A. Rosen, Chemist, Public Health Service, 4676 Columbia Parkway, Cincinnati, Ohio

Mr. L. L. Nickens, Industrial Relations Superintendent, General Chemical Division, Box 2830, Baton Rouge, Louisiana

Mr. Lawrence J. Noel, III, Farm Bureau Board Member, Louisiana Farm Bureau Federation, Box 466, Donaldsonville, Louisiana

Mr. Francis F. Escoffier, United States Army Corps of Engineers, P. O. Box 1169, Mobile, Alabama

Cecilia M. Pizzo, Editor and Publisher, Voice of New Orleans, P. O. Box 52694, New Orleans, Louisiana

OTHERS IN ATTENDANCE (Continued):

Mr. S. Vance, Farm Director, WWL Radio, Roosevelt Hotel, New Orleans, Louisiana

Mr. James T. Davis, Fisheries Research Biologist, Louisiana Wild Life and Fisheries Commission, P. O. Box 4004, Monroe, Louisiana

* * *

PROCEEDINGS

OPENING STATEMENT
BY
MR. MURRAY STEIN

MR. STEIN: The conference is open.

This conference in the matter of pollution of the interstate waters of the Lower Mississippi River and its tributaries, involving the States of Arkansas, Tennessee, Mississippi, Louisiana, and the Department of Health, Education, and Welfare, is being held under the provisions of Section 8 of the Federal Water Pollution Control Act.

Under the provisions of the Act, the Secretary of Health, Education, and Welfare is required to call a conference of this type, when on the basis of reports, surveys or studies he has reason to believe that pollution of interstate waters subject to abatement under the Federal Act is occurring. If the facts adduced at this conference indicate that other States in the Mississippi River Basin are contributing to the pollution problems which resulted in the calling of this conference, the Secretary may, at a later date, increase the area covered by the conference.

The purpose of the conference is to bring together the State water pollution control agencies, the representatives of the Department of Health, Education, and Welfare, and other interested parties to review the existing situation, the progress which has been made, and to lay a basis for future action by all parties concerned, and to give the States, localities, and industries an opportunity to take any remedial action which may be indicated under State and local law.

The conference technique is rather an old one. It is used by many State agencies informally in the normal conduct of their business in the field of water pollution control. The concept of the conference was proposed by the United States Supreme Court as long ago as 1921 in the famous case of New York against New Jersey involving interstate pollution. I would like to quote from this Court opinion:

> "We cannot withhold the suggestion, inspired by the consideration of this case, that the grave problem of sewage disposal presented by the large and growing populations living on the shores of New York Bay is one more likely to be wisely solved by cooperative study and by conference and mutual concession on the part of representatives of the

"States so vitally interested in it than by proceedings in any court however constituted."

We strongly support the conference technique and we measure our success by the situations which are solved at the conference stages, rather than by the court actions we bring.

I think in this case a conference is most apt on brief preliminary consideration of the situation. The facts are most complex and, as is not always the case in pollution cases, may be opened up to some dispute.

As we understand it, in order to assure that all the facts will come out and to try to arrive at equitable conclusions, the Department of Health, Education, and Welfare will have its representatives describe their findings and their methodology with some particularity.

We would expect that all others who may have other points of view would be given an opportunity to express these points of view, and, if necessary, to handle this, we will have our experts up here with the people representing other points of view. They can have a colloquy here, an exchange of views, and a direct confrontation.

I think in a complicated situation of this kind, this is about the only way we can see if we can arrive at areas of agreement, and what areas we possibly do not agree on.

Under Section 8 of the Federal Water Pollution Control Act, the Secretary of Health, Education, and Welfare has notified the official State water pollution control agencies of this conference. These agencies are the Arkansas State Water Pollution Control Commission, the Tennessee Stream Control Board, the Mississippi State Board of Health, and the Louisiana Stream Control Commission.

Arkansas will be represented by Mr. Marvin Wood and Mr. Ed Albares; Tennessee will be represented by Mr. S. Leary Jones; Mississippi will be represented by Mr. J. E. Johnston; and Louisiana will be represented by Mr. Robert Lafleur and Mr. John E. Trygg. Mr. Jerome Svore of the Department of Health, Education, and Welfare, with headquarters in Dallas, Texas, has been designated as conferee for the Federal Government.

My name is Murray Stein. I am from Washington, D. C., headquarters of the Department of Health, Education, and Welfare, and I am the representative of the Secretary of Health, Education, and Welfare, Anthony J. Celebrezze.

The representatives of the official agencies are privileged to bring whomever they wish to the conference and have them participate in the conference. However, this is a conference between the State representatives and the representatives of the Department of Health, Education, and Welfare, and these parties constitute the conferees.

Both the States and the Federal Government have responsibilities in dealing with interstate water pollution control problems. The Federal Water Pollution Control Act declares that the States have primary rights and responsibilities for taking action to abate and control interstate pollution. It has always been the policy of the Department of Health, Education, and Welfare to give full recognition to this traditional role of the States. The function of the Department is to encourage the States in these activities. However, the Department of Health, Education, and Welfare is charged by law with specific responsibilities in connection with interstate pollution control problems.

The Federal Water Pollution Control Act provides that pollution of interstate waters, whether the matter causing or contributing to such pollution is discharged directly into such waters or reaches such waters after discharge into a tributary of such waters, which endangers the health or welfare of persons in a State other than that in which the discharge originates, is subject to abatement. The conference will be useful, we hope, in providing a clear picture of the problem, in delineating the progress which has already been accomplished, and in indicating what still needs to be done to correct the problem in these interstate waters.

Under the Federal law, the Secretary is required at the conclusion of the conference to prepare a summary of it which will be sent to all the conferees. The summary, according to law, must include the following:

1. Occurrence of pollution of interstate waters subject to abatement under the Federal Act;
2. Adequacy of measures taken toward abatement of pollution; and
3. Nature of delays, if any, being encountered in abating the pollution.

Subsequent to the holding of a conference, the Secretary of Health, Education, and Welfare is required to make recommendations for remedial action if such recommendations are indicated.

At this conference, it is our privilege to have with us three members of the President's Water Pollution Control Advisory Board, and I would like them to stand up as I introduce them at this time.

First we have Mrs. Burnette Hennington of Jackson, Mississippi, the latest member of the Board and the first woman to serve on the Board.

(Applause.)

Next, we have Mr. John Biggs of Olympia, Washington. Mr. Biggs.

(Applause.)

Mr. William Towell of Jefferson City, Missouri. Mr. Towell.

(Applause.)

Now a word about the procedure governing the conduct of the conference. A record and verbatim transcript will be made of the conference by Mr. Al Zimmer. Mr. Zimmer is making this transcript report for the purpose of aiding us in preparing a summary, and also providing a complete record of what is said here. We will make copies of the summary and transcript available to the official water pollution control agencies of Arkansas, Tennessee, Mississippi and Louisiana. We have found that generally for the purpose of maintaining relationships within a Region and a State that the people who wish transcripts should request them through their State agency, rather than come directly to the Federal Government. The reason for this is that we would prefer the people who are interested in the problem to follow their normal relations in dealing with State agencies rather than the Federal Government on these matters when the conference has been concluded. This has worked successfully in the past and we will be most happy to make this material available to the States for distribution. There is no charge for this.

All the conferees will be called upon to make statements. The conferees, in addition, may call upon participants whom they have invited to the conference to make statements. At the conclusion of such statements, the conferees will be given an opportunity to comment or ask questions, and at the conclusion of the conferees' comments or questions I may ask a question or two. This procedure has proven effective in the past in developing a clear statement of the problem and in reaching agreements on equitable solutions.

So there will be no confusion, this is a conference between the Federal Government and the State agencies involved.

At the conclusion of any statement, only the conferees can comment or ask questions. However, if anyone is called upon to participate, they will be given an opportunity to state fully their positions, and if there is a difference with someone else and another expert or another point of view here, we will have that person come up and there will be full opportunity for a colloquy and exchange of views.

At the end of all the statements, we will have a discussion among the conferees and try to arrive at a basis of agreement on the facts of the situation. Then we will attempt to summarize the conference orally, giving the conferees, of course, the right to amend or suggest modifications of the summary.

I would suggest that all speakers and participants, other than the conferees making statements, come to the lectern and identify themselves for the purposes of the record.

At this point we would like to call on Mr. Jerome Svore for the Department of Health, Education, and Welfare.

Mr. Svore.

STATEMENT OF JEROME SVORE, CONFEREE AND REGIONAL PROGRAM DIRECTOR, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, WATER SUPPLY AND POLLUTION CONTROL, DALLAS REGION, DALLAS, TEXAS

MR. SVORE: Thank you, Mr. Chairman.

Can you hear me in the back of the room?

I would like to begin the Federal portion of this presentation --

MR. JONES: Murray, are the statements going to be made under oath?

MR. STEIN: Pardon me. One of the conferees has asked a question.

This is a conference. Anyone making a statement is not under oath.

If we ever have to go to a hearing procedure, people are under oath in that procedure. While we will try to have a full colloquy to get at the facts, there is no cross examination either as such. No one is obliged to make a statement or answer a question.

MR. JONES: Wouldn't it save a lot of time to have them make their statements under oath?

MR. STEIN: I don't know that it would save any time.

Secondly, I am not at all sure that we are authorized to have statements under oath at the conference.

The Congress passed a law governing the procedure in three stages: (1) Conference; (2) hearing; and (3) court action. Our counsel back in Washington have considered that an oath would not be appropriate at this stage.

MR. JONES: It would save a lot of time to get at the full facts right now.

MR. STEIN: Originally, sir, you will recall that the law permitted us to go to a hearing immediately.

At the request of the State agencies, when the law was amended this conference procedure was put in. I don't know that the purpose was to save time, but I do think that in the long run the conference procedure has proved that it has saved time, because most of the cases are solved at the conference stage.

Mr. Svore.

MR. SVORE: Thank you, Mr. Chairman.

I would like to begin the Federal portion of this presentation by calling on Mr. K. E. Biglane, the Chief for Eastern Operations of the Water Projects Section of the Technical Services Branch of Washington, D. C.

K. E. Biglane

STATEMENT OF KENNETH E. BIGLANE, CHIEF FOR EASTERN OPERATIONS, WATER PROJECTS SECTION, TECHNICAL SERVICES BRANCH, PUBLIC HEALTH SERVICE, WASHINGTON, D.C.

MR. BIGLANE: Mr. Chairman, conferees and ladies and gentlemen:

It is nice to be home.

The title of my report is the "Technical Services Branch Report on Fish Kills on the Lower Mississippi River."

For the information of some of the conferees, I was formerly employed by the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control, first as an aquatic biologist from 1952-56, and then as Chief of the Division of Water Pollution Control and Executive Secretary to the Louisiana Stream Control Commission from 1956 through 1962. Because of my experience in Louisiana I was not surprised when on November 18, 1963, Mr. Robert Lafleur, Chief, Division of Water Pollution Control, Louisiana State Wild Life and Fisheries Commission, requested assistance from the Public Health Service in connection with a massive fish kill of many species of fish on the lower Mississippi River. Kills of this nature have been observed annually in this river since 1960.

Mr. Lafleur said that reports coming to him indicated that the kill this year extended as far north as St. Louis, Missouri, and south into the brackish water areas at the mouth of the Mississippi River. The kills to the north were reported to him by tugboat crews and as yet were unconfirmed by water pollution control officials in Kentucky, Mississippi, Missouri, or Tennessee.

Mr. Lafleur stated that it was extremely difficult to estimate the number of fish killed because there was good reason to believe that only a small portion of the die-off has actually been observed. The following table is his best estimate of the number of fish killed.

AN ESTIMATE OF FISH MORTALITY

	Mississippi		Atchafalaya
Year	Fresh Water	Salt Water	Fresh Water
1960	100,000	1,000,000	2,500,000
1961	25,000	200,000	50,000
1962	25,000	200,000	50,000
1963	75,000	5,000,000	100,000

Continuing, he observed that the kills in 1961 and 1962 were not as severe as those of either 1960 or 1963. However, in all four years the same general pattern was noted, except that a larger variety of species were found dead or dying in the years following 1960. Catfish, drum, buffalo and shad were observed swimming near the surface of the river and dying. In brackish waters near the Gulf of Mexico, whole schools of menhaden and numerous mullet, sea trout and marine catfish died.

Mr. Lafleur requested two forms of technical assistance. He asked the Public Health Service to obtain samples in the St. Louis and Memphis areas and run determinations for pesticides or other likely toxic agents. He suggested that the samples be taken at the interface of mud and water at the bottom of the river. Mr. Lafleur also requested that biologists from the Sanitary Engineering Center at Cincinnati, Ohio, be dispatched to Louisiana to make observations and assist the State in determining the cause of the fish kills. He stated that Dr. Clarence M. Tarzwell had assisted the State in 1960 when the kills were first noticed and that further assistance from him would be welcomed.

At this point, and for the consideration of the conferees, I would like to make some observations based on my experience with water pollution control activites and fish kills in the State of Louisiana. These observations will cover the period from 1958 through 1962.

Water Pollution Control Practices in Louisiana

K. E. Biglane

Louisiana's Division of Water Pollution Control has always subscribed to the theory that the aquatic biota represents a measurable indication of the general health of a stream. The aquatic environment represents a gigantic aquarium in which the effect, on life, of man's vomitus of wastes and poisons are manifested in a manner similar to those reactions observed in laboratory experiments.

Fish kills and other aquatic life mortalities which are viewed with concern by water pollution control workers in Louisiana fall into three categories.

1. Those caused by natural catastrophes which produce violent physical or chemical changes in the aquatic environment.
2. Those caused by the discharge of industrial and municipal wastes into surface waters.
3. Those caused as a result of pesticides and other toxic materials finding their way into the habitat.

A water pollution scientist soon learns that one of the best methods of solving a fish kill is first to eliminate elements of those categories which could not have caused the damage. This elimination method calls for background data on water quality in any given area. Therefore, in 1958 Louisiana initiated a monthly water quality analysis program involving 36 streams in the State. The year before, a continuous accumulation of water quality data from the Mississippi River in the Baton Rouge area was commenced. Subsequently, this activity was expanded to Luling, Louisiana, an area just above New Orleans. This information is valuable in interpreting those aquatic conditions that are conducive for the maintenance of life and following the continuity of bio-dynamic cycles. A history of water quality data is also useful in determining what may have caused a damage to occur as a result of the discharge of a waste, or, in the case of wilderness or semi-wilderness areas, what natural catastrophe may have befallen the biota.

Stream scientists working for Louisiana's Division of Water Pollution Control soon become educated to the different types of water pollution that are found in their State from time to time. Wastes from sugar factories, sweet potato canneries, pulp and paper mills, oil field brines, naval stores plants, chemical plants, sand and gravel miners, oil refineries, fish processing plants, municipal sewages, and slaughter houses all have two things in common. They can degrade water and they can kill aquatic life. Their point in time, their point source, and their physical and chemical alteration of the aquatic environment, however, offer clues to their dissimilarities.

A stream scientist is able to determine causes of aquatic mortalities resulting from nature's alteration of this same environment. The 40-degree drop in temperature within 24 hours along the Louisiana coast in the winter of 1959 littered the estuaries with fish, shrimp, and crabs that failed to become acclimatized to the sudden cold. Stagnation resulting from low water and 90-degree-plus temperatures have also been observed to cause mortalities in the Atchafalaya Basin, Catahoula Lake, and numerous other streams in the backwater areas of the State. Algal blooms resulting in low dissolved oxygen and high alkalinities cause fish kills in the State, but these are usually confined to small impoundments and are seldom observed in running streams.

K. E. Biglane

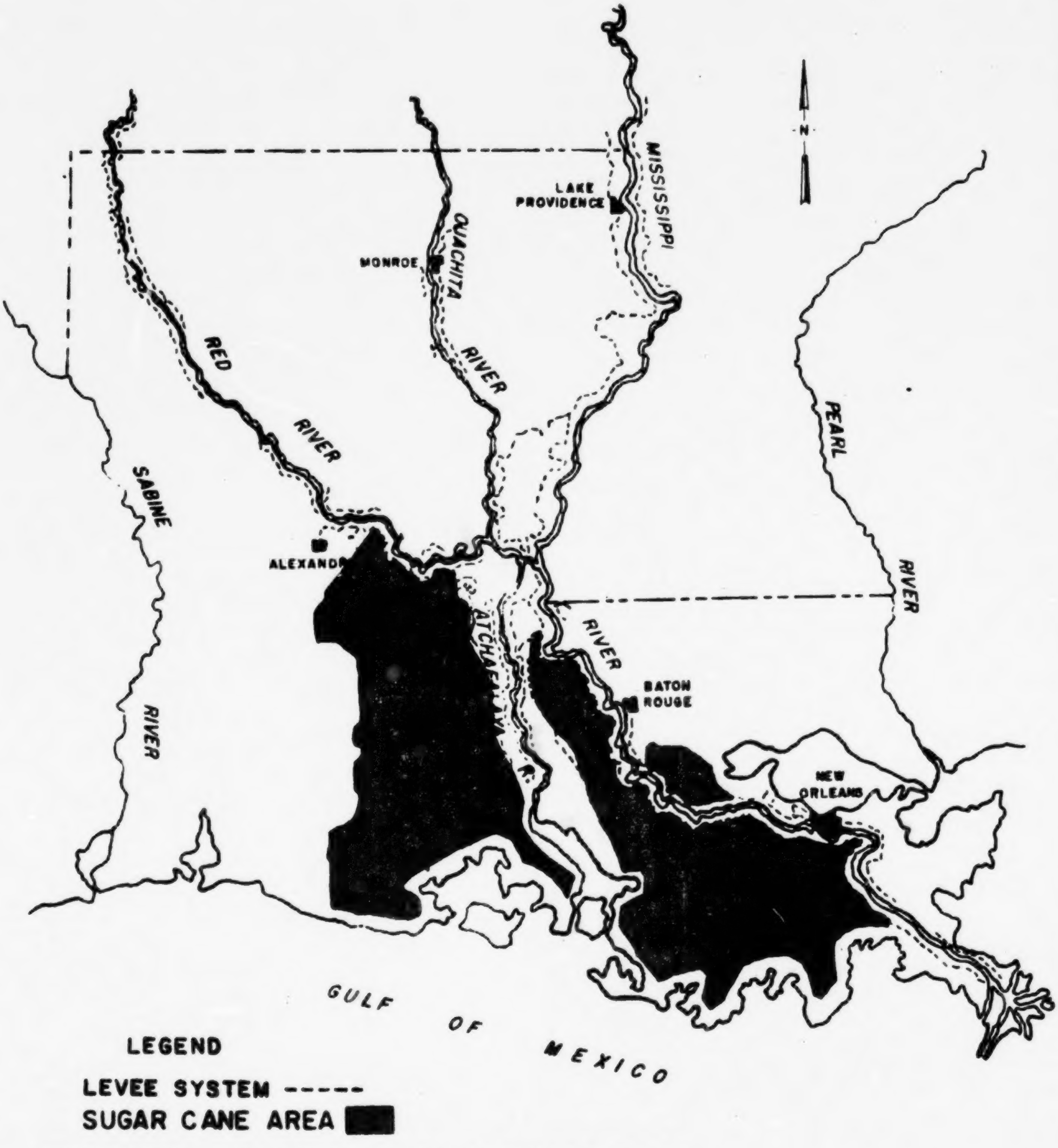
Aquatic Animal Kills in the Sugar Cane Growing Areas of Louisiana

May I have the slides at this time, please?

The picture here (indicating) is of the State of Louisiana, showing some of its major river basins, starting from the western portion of the State, the Sabine River, the Red River, coming in through Shreveport, the Ouachita down through Monroe, then the Mississippi on the eastern border, and finally the Pearl on the far eastern border.

The areas in red represent those parishes in which sugar cane is grown. The aquatic animal kills about which I am to speak occurred in the southern portion of the red area indication that you see on the map.

When fish die-offs on a large scale were reported in some of the sugar cane growing and processing parishes of the State in the summer of 1958, Louisiana Division personnel became alarmed over the fact that our usual water detecting analyses failed to reveal any changes in water quality. No adverse climatic conditions or water flows were evident, no sugar factories were operating, no other known industrial or municipal discharges were found to be abnormal and no intrusions from the Gulf of Mexico were noted.


MISSISSIPPI
LAKE PROVIDENCE
MONROE
QUACHITA RIVER
RED RIVER
ALEXANDRIA
SABINE RIVER
PEARL RIVER
ATCHAFALAYA R.
RIVER
BATON ROUGE
NEW ORLEANS
GULF OF MEXICO
N
LEGEND
LEVEE SYSTEM -----
SUGAR CANE AREA ■

RED RIVER–MISSISSIPPI RIVER DRAINAGE BASIN IN LOUISIANA

Not only were fish dying, but snakes, eels, and turtles were succumbing to whatever was in the streams. After several investigations by Division personnel, we arrived at the following facts which, to us, seemed to be closely related.

1. Aerial applications of a pesticide named Endrin were being made on the cane fields.
2. Fish and other animal mortalities would occur soon after a rain followed by runoff from the cane fields.
3. Fish and animal mortalities ceased when aerial applications of endrin ceased for the year.

Analyses by our Division and the Division of Agricultural Chemistry, Louisiana Department of Agriculture and Immigration, failed to reveal any presence of pesticides or other toxic materials in water or fish.

In 1959, the mortalities reoccurred during the same season as in 1958 and in the same pattern. However, this year the Louisiana Division and personnel noted that "During the 1959 growing season these kills reached alarming proportions with complaints being received by the Division of Water Pollution Control on an almost daily basis. In fact, many days brought complaints of kills in different watersheds over a several parish area." (Louisiana Wild Life and Fisheries Commission Biennial, 1960-61).

I have witnessed aerial applications of Endrin on sugar cane fields around Houma, Thibodaux, and Donaldsonville, Louisiana. After subsequent rains, I have returned to such streams as Bayou Pierre Part near Donaldsonville, Bayou Black near Houma, and Bayou Chevrieul near Thibodaux, and I have seen many thousands of fish and snakes, turtles, eels, dead and dying.

During the application season of 1960, more than 32 fish and other animal kills were observed in the cane growing areas, but the Division of Water Pollution Control laboratory was still unable to detect toxic materials in fish and water. The sports public, indignant citizens, harassed elected officials, and the press were all demanding that something be done. Dead fish were observed to be clogging the intake of the Franklin, Louisiana, power plant and were dying in Bayou Teche, a stream used as a source of drinking water for the town of Franklin.

A public information program was conducted by the Division through the news media on the dangers of careless application of Endrin. Regulations for the supervision of aerial applications of the pesticide, the marking of cane fields, the plugging of drainage ditches leading away from fields, and the halting of applications immediately before a rain was forecast were recommended to the Louisiana Stream

Control Commission by the Division in August, 1959. No action was taken on these recommendations, but the Commission encouraged enforcement measures against airplane pilots who carelessly dropped pesticides in streams.

In 1961 the pattern and intensity of the kills reoccurred and the Stream Control Commission called on the Pesticide Pollution Project Unit of the U. S. Public Health Service, Atlanta, Georgia, for assistance in determining the cause of these kills. A report on this project's findings will be given to this conference.

Mr. Chairman, I would now like to submit for the record a copy of the report entitled "Pesticide Pollution Studies, Progress Report," U. S. Department of Health, Education, and Welfare, Public Health Service.

MR. STEIN: Without objection, it will be received as an exhibit, but will not be entered in the record.

(The document referred to may be found in the files of the Department.)

MR. BIGLANE: In 1962, there were no kills in the cane growing areas during the application season recorded by our Division. It may be significant, however, that the extreme drought conditions experienced by the State beginning in 1962 and continuing into 1963, resulted in minimum runoff from the cane fields.

Aquatic Animal Kills in the Atchafalaya and Mississippi Rivers in Louisiana

After three summer seasons of extensive fish mortalities in the cane growing areas of the State, I was perplexed by a report on November 17, 1960, that extensive die-offs were being observed in the Atchafalaya River near Krotz Springs. This river is formed by the Red River and its tributaries and also receives a large amount of water diverted from the Mississippi River. The Atchafalaya flows through a wilderness area to the Gulf of Mexico. Flood protection levees are located on either side of the flood plain and form an enclosure about 17 miles wide and 75 miles long. No industries are located inside this flood plain, and it is sparsely settled because of the danger of floodwaters. Within one or two weeks after the Atchafalaya reports, observations of a similar die-off were noted in the Mississippi River from Lake Providence (480 AHP) to the estuarine areas at the mouth of the Mississippi River. Fish were dying in the Atchafalaya from Old River to Morgan City. Division personnel recorded that this was "the most spectacular fish mortality ever noted in Louisiana" (Louisiana Wild Life and Fisheries Commission Biennial, 1960-61).

Species of fish affected in the Mississippi and Atchafalaya Rivers included carp, catfish, fresh water drum, and threadfin shad. In the estuarine areas, speckled trout and other species of marine fishes were dying. Approximately 95 percent of the fish dying were catfish. The Division's biologists reported that the fish were hemorrhaging about the fins and mouth and in every instance the catfish were observed to have a distended abdomen. The digestive tract was found to contain only gas or air and a small amount of frothy material. Analysis of the bottom fauna in the Atchafalaya revealed a plentiful supply of food organisms, easily available to the fish.

Again, data from Louisiana's water quality monitoring program revealed nothing which could be considered out of the ordinary. Chemical and bioassay experiments in the Division's laboratory failed to demonstrate anything of a toxic nature from muds, water, or fish. Muds, fishes, and some invertebrate animals were sent to the R. A. Taft Sanitary Engineering Center in Cincinnati, Ohio, and two laboratories of the U. S. Fish and Wildlife Service. The U. S. Fish and Wildlife Laboratory in Kearneysville, West

Virginia, reported that the examination of fish was inconclusive, but indicated the possible presence of abdominal dropsy. The fish they received, however, arrived in poor condition due to thawing. The Taft Center reported that no insecticides were found and, therefore, the Louisiana Division of Water Pollution Control pursued the disease theory. Our bacteriologist began to prepare cultures which would identify Aeromonas liquifaciens, an organism which caused abdominal dropsy in fish. He reported, "Bacterial cultures were made utilizing parts of the viscera and blood of affected fish and tests conducted on these cultures indicated the presence of Aeromonas liquefaciens" (Louisiana Wildlife and Fisheries Biennial 1960-61).

Mr. Chairman, later on in this conference there will be evidence presented by the Department of the Interior which shows that this was not in fact abdominal dropsy. These kills were not due to abdominal dropsy.

MR. STEIN: Thank you.

MR. BIGLANE: The kills persisted into early February 1961, and did not reoccur until the fall of 1961. This time the same geographic areas were involved, the seasonal pattern was reestablished, but the intensity of the kill was not as evident. The same statement holds true for 1962. We did not report the 1961 and 1962 kills in the

Mississippi and Atchafalaya Rivers to the Public Health Service, Pollution-Caused Fish Kills annual compilation, because we did not think pollution was responsible for the mortalities.

Action on the Request for Assistance from Louisiana

After receipt of the request for assistance the situation was reviewed by scientists and engineers of the Division of Water Supply and Pollution Control, Public Health Service. Because of the persistent recurring nature of the kills, the broad spectrum of species of fish involved, the diversity of water environments affected and possible public health implications, a high priority was assigned to the request for action, and all available resources of the full division were made available for the investigation.

On the day that the call was received, the Technical Services Branch called the Director, Bureau of Sport Fisheries and Wildlife, Department of the Interior, and described the situation to him. The Director suggested that Mr. William Harth, Superintendent of Fisheries, Department of Conservation, State Office Building, Springfield, Illinois, or Mr. Herbert Fisher, Missouri State Conservation Commission, Farm Bureau Building, Jefferson City, Missouri, would be willing to assist in obtaining samples from the Mississippi near St. Louis, Missouri.

The Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio, was then contacted and arrangements were made to obtain the samples and make the analyses.

The arrangements to obtain the samples from Mr. Harth and Mr. Fisher were made the same date. In addition, Mr. Lafleur was requested to assist in obtaining samples of dead fish for tissue tests. In addition it was also decided to analyze recent samples from five network stations on the lower Mississippi River for pesticides. Monthly samples are taken at stations of the National Water Quality Network. The carbon-chloroform extracts would give a record of the recent organic pollution in the Lower Mississippi.

Two research scientists from the Taft Sanitary Engineering Center in Cincinnati, Ohio, visited the Lower Mississippi River during the first week in December. The scientists, Dr. Donald Mount, a fisheries research biologist, and Mr. Thomas Maloney, an aquatic biologist, made on-site investigations and collected specimens and samples for laboratory study.

Their trip started with a thorough briefing session by biologists at Baton Rouge. Field visits were made by boat along the Mississippi River near Baton Rouge, into a portion of the Intracoastal Waterway, and into the estuarine areas of the Gulf of Mexico.

Initial Results

In the search for the cause of the fish kills numerous possibilities were checked. Scientists of the U. S. Fish and Wildlife Service proved that the kill was not caused by parasitic or bacterial disease.

Botulism poisoning was suspected, but personnel of the Public Health Service found no evidence of botulism. Tissues of dying catfish were fed to healthy catfish to see whether a viral or bacterial disease would be transmitted; this investigation yielded negative results.

Analysis of brain tissue indicated that death was not due to organic phosphorous insecticides. Emission spectographic analysis of tissue showed that toxic concentrations of metals were not present. However, blood cell counts and microscopic examination of the kidney indicated the effects of a toxicant.

Several simultaneous experiments were conducted to detect the presence of toxic materials. Extracts of the mud taken from the area of the fish kills, when placed in aquaria containing healthy fish, resulted in death. Extracts of the mud taken from the area of the fish kills, when placed in aquaria containing healthy fish, resulted in death. Extracts of the tissues of dying fish, when dissolved in the water of the aquaria, also resulted in the death of healthy fish. In both cases death occurred with the same symptoms as those observed in Louisiana.

Immediate steps were taken to identify common substances in the extracts from the mud, from dead fish obtained in Louisiana, and from the fish killed experimentally in the laboratory. Rigorous analyses were made independently by five teams of investigators. Four of these were within the Public Health Service, and one was a private research laboratory.

Endrin was found to be present in all extracts, and dieldrin and other chlorinated hydrocarbon insecticides were present in most extracts.

Endrin Experiments

The researchers at the Taft Sanitary Engineering Center conceived and executed a series of tests to determine if Endrin in the blood of dead fish taken from the Mississippi River was present in lethal amounts. Endrin was chosen because of its presence in every dead and dying fish examined.

The investigations with Endrin required three sets of determinations. First, the amount of Endrin in the bloodstream of fish killed under test conditions was determined; second, the amount of Endrin in the bloodstream of fish that had died in the Mississippi River was determined; and third, the amount of Endrin in apparently healthy fish taken from the Mississippi River was determined. The purpose of these three determinations was to establish the threshold between sublethal and lethal concentrations of Endrin in the blood of Mississippi fish and to determine if the amount of Endrin found in dying fish in the Mississippi River would have been sufficient to kill test fish in the laboratory.

While the preceding investigations were going on, other scientists were analyzing samples of water from the Mississippi River. During the first week in December, as requested by Mr. Lafleur, four water samples were collected near the bottom of the river above and below St. Louis, Missouri. These samples were shipped in special containers to the Sanitary Engineering Center. Dieldrin and Endrin were present in all four samples but Endrin concentration was less than 0.001 p.p.b.

In the routine operation of the National Water Quality Network, organic material is concentrated on activated carbon at 95 stations. The organics are then desorbed with a solvent, the amount of organic material is measured, and the resulting extract is stored for future use. Twenty-eight of these extracts of water samples were taken from the Mississippi River in the four months of 1963 just prior to the first evidence of the winter kill.

Analysis of these 28 samples provided a recent history of average concentrations of Endrin and Dieldrin in the river. Dieldrin was found at all stations. Endrin was not found in quantifiable amounts above Cape Girardeau, Missouri, but it was found there and at all stations downstream. Dieldrin varied from non-detectable to 67 parts per trillion. Endrin below Cape Girardeau varied from 7 to 214 parts per trillion. A more detailed report of these and other analyses by the Public Health Service will be given at this conference, Mr. Chairman.

I do have some data that was presented to me just shortly before I left Washington, and this data was not received in time to incorporate it into the report. It contains some of the results of the grab samples taken at several stations in Louisiana, Arkansas and Mississippi.

With your permission, Mr. Chairman, I would like to read the results of these mud analyses into the record.

MR. STEIN: Go right ahead, Mr. Biglane.

MR. BIGLANE: Endrin and Dieldrin contamination noted in muds collected from various streams in the southern portion of the Mississippi River drainage basin.

Now, the investigators took samples at Red River at Alexandria; Black River at Jonesville; the Atchafalaya River at Morgan City; the Atchafalaya River at Krotz Springs, Louisiana; the Big Black River at Warren-Hinds County line in Mississippi; the Yazoo River at Reelwood, Mississippi; the Arkansas River at Little Rock, Arkansas; the Old River Diversion between the Mississippi and the Atchafalaya; and the Mississippi River at St. Francisville.

This represents nine stations. From these nine stations only four --

MR. STEIN: Mr. Biglane?

MR. BIGLANE: Sir?

MR. STEIN: I understand that is Redwood, Mississippi, not "Reelwood."

MR. BIGLANE: Excuse me. Redwood, Mississippi.

From these nine stations, only four of these mud samples proved to be positive for Endrin or Dieldrin, and they are the Black River at Jonesville, where Endrin was three parts per billion and Dieldrin was eight parts per billion; the Atchafalaya River at Krotz Springs, where Endrin was 24 parts per billion and Dieldrin was 12 parts per billion; at the Big Black River in Mississippi, where Endrin was 15 parts per billion and Dieldrin was 10 parts per billion; and, finally, the Mississippi River at St. Francisville, where Endrin was 4 parts per billion and Dieldrin was 4 parts per billion.

Mr. Chairman, this concludes my testimony.

MR. STEIN: Are there any comments or questions?

MR. JONES: Mention was made of these unconfirmed reports of the fish kills below Memphis. What were the dates on those?

MR. BIGLANE: I didn't understand your question, Mr. Jones.

MR. JONES: Mention is made in your report of unconfirmed fish kills below Memphis.

MR. BIGLANE: Oh, yes, sir.

When Mr. Lafleur called the Technical Services Branch in November, he made reference to the fact that his understanding was that fish were being killed as far north as St. Louis, but he had not confirmed those reports.

MR. JONES: Did anyone see the dead fish? We have been trying to find the dates on it. That is the reason I am asking you.

MR. BIGLANE: No, sir, I can't answer your question.

MR. JONES: I think the report says a tugboat captain saw them.

MR. BIGLANE: This is what Mr. Lafleur reported to us.

MR. JONES: We have been trying to tie that in with some dates on a fish kill from other regions, but no one knows what month or what year it was -- what year, perhaps, but not the month.

Our Game and Fish Commission couldn't find any evidence of it.

MR. BIGLANE: Yes, sir.

MR. LAFLEUR: I might answer that.

MR. STEIN: Mr. Lafleur.

MR. LAFLEUR: The date that I can tie down to that was either November or December of 1963.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you very much, Mr. Biglane, for a very excellent presentation.

We in the Federal Government were indeed fortunate to have a Louisiana expert on our staff. I assure you this wasn't premeditated when we hired him.

Mr. Svore?

MR. SVORE: Thank you, Mr. Chairman.

I would next like to present Dr. Clarence M. Tarzwell. Dr. Tarzwell is Chief of the Aquatic Biology Section, Basic and Applied Sciences Branch of the Public Health Service, at the Taft Center.

Dr. Tarzwell is the Public Health Service senior Ph.D. in this field, and I know that during the last ten years he has been very active in trying to develop an adequate program for the establishment of water quality standards in this field and their effect on aquatic life.

I would also like to mention, Mr. Chairman, that Dr. Tarzwell has been in this field for the last twenty-five years and is well recognized as an expert in this field, and is represented on many Federal committees concerned with this problem.

Dr. Tarzwell.

STATEMENT OF DR. CLARENCE M. TARZWELL,
CHIEF OF THE AQUATIC BIOLOGY SECTION,
BASIC AND APPLIED SCIENCES BRANCH, PUBLIC
HEALTH SERVICE, ROBERT A. TAFT SANITARY
ENGINEERING CENTER, CINCINNATI, OHIO

DR. TARZWELL: Mr. Chairman, conferees, ladies and gentlemen:

C. M. Tarzwell

The killing of fish through the application of pesticides is not a new or recent phenomenon. For many years, there has been a conflict of interest between conservationists and those who are charged with the control of pests. Wildlife workers have objected to the widespread and sometimes indiscriminate use of pesticide materials because of their adverse effects on aquatic and other forms of life. In this country the earliest conflicts of interest centered around mosquito control operations for malaria control. I first had an introduction to some of these problems in 1939, when I became a member of a team investigating effects of malaria control on aquatic life in the TVA reservoirs. At that time we studied the effects on fishes and their food organisms of Paris Green and fuel oil used for the control of malaria mosquitoes as larvicides. Certain detrimental effects were demonstrated. With the advent of DDT and its production in quantities needed for malaria control work, great interest was expressed in the effects of this material on aquatic life. Investigations to determine the effects of DDT on aquatic organisms were undertaken by Federal and State agencies and a number of universities. It soon became apparent that DDT was very toxic to many aquatic organisms and that studies should be made to determine concentrations of this material which could be used for the control of malaria mosquitoes without undue harm to aquatic life. The Public Health Service and the Army agreed to withhold or limit larvicidal uses of DDT until these studies could be carried out. Investigations to supply this data were undertaken at the Technical Development Laboratories of the Public Health Service in Savannah, Georgia, in 1945 under the direction of the speaker. We undertook studies of the effects of routine weekly applications of DDT larvicides, since such applications are used for control of malaria mosquitoes, whereas others studied only single applications.

While stress was laid on DDT, studies were also made with DDD, Chlordane, and BHC. It was found that the rate of application and formulation were important factors determining toxicity. It was also found that there was considerable variations in the toxicity of these materials to aquatic organisms.. These studies were carried on over a period of three years, so that their long-term effects might be observed. It was found that some organisms decreased in number or virtually disappeared, while other forms increased greatly in numbers and occupied the space of the organisms which were eliminated. Olgichaetes and nematodes reached peak levels of 30,000 and 60,000 individuals per square foot of water surface to a depth of two inches, whereas Mayflies, certain Odonato, the Trichoptera, and certain Dipteria decreased in numbers. On the basis of these studies it was recommended that for larviciding in problem areas, only dosages for hand application should not exceed 0.05 lb/acre and for airplane application 0.1 lb/acre.

Upon my transfer to the Sanitary Engineering Center in 1948, investigations on the effects of pesticides on aquatic life were continued with stress on laboratory studies. Methods and equipment were developed for bioassay studies for the determination of the toxicity of various materials to fishes. Suggested standard methods for the conducting of bioassays were developed. Dr. Peter Doudoroff, a recognized authority on bioassay and the toxicity of materials to fishes, was engaged full time in these investigations. In the mid 40's, he authored a book in conjunction with Messrs. Hart and Greenbank, which was the pioneering work in this country on equipment and method of bioassay and the report of the results. In 1949, he became chairman of the Subcommittee on Toxicity of the Water Pollution Control Federation. This committee was charged with the task of developing standard bioassay methods for the determination of the toxicity of waste and other materials to fishes. The report of this committee was published in the Journal of the Water Pollution Control Federation in the early 1950's. Concurrently in 1950, studies were undertaken to determine the toxicity of synthetic organic pesticides to fishes. Although some long-term studies were attempted in the mid-50's, the bulk of our efforts was devoted to the determination of the acute toxicity of the principle chlorinated hydrocarbon and organic phosphorous pesticides to representative species of fish. Between 1950 and 1959, studies were made of the acute toxicity of the ten most widely used chlorinated hydrocarbons and the thirteen most important organic phosphorous pesticides to four species of fishes. In addition, the toxicity of a number of these were determined for ten species of fish and a number of invertebrate organisms important as fish food. Studies were also made of the toxicity of runoff water from areas treated with pesticides. In an area experimentally treated with Dieldrin, for the control of the white fringed beetle, it was found that run-off from the first rain following treatment was toxic to fishes in a dilution of one in three.

Concurrent with these studies, I served as chairman of the Toxicity Subcommittee of the Standard Methods Committee, which prepared the Eleventh Edition of Standard Methods for the Analysis of Waters and Waste Waters. Report of this committee on bioassay methods for the determination of the acute toxicity of materials to fishes was published in the Eleventh Edition of Standard Methods. These methods are now widely being used by Federal and State organizations and industries. They had, among other purposes, the establishment of uniform methods for the carrying out of bioassay and for the expression and reporting of results. They stressed the necessity for describing the quality of dilution water used in the test, the concentration of potential toxicants used, the species of fish, their size and age, the length of the test and the methods of reporting results. Such data is essential in order to understand the result of the test, and in order that results obtained by different workers may be compared. This is necessary since there is considerable variation in the toxicity of the same material to different species of fish and the conditions of the test can greatly influence the toxicity of a material. Further, these proposed standard methods made it clear that in these tests the total weight of experimental fish should not exceed two grams per liter of test solution.

As our work progressed, we expanded our studies to include invertebrate animals including aquatic insects, microcrustacea, and crayfish. Among the species and materials studied to date, we have found an over-all variation in toxicity of about twelve thousand times. For example, Endrin is the most toxic material to fish that we have ever tested, including the nerve gases. It has a 96-hour TL_m of 0.6 ppb for bluegill, 0.5 ppb for trout, and between 0.2 and 0.4 for catfish. On the basis of these laboratory studies, half the bluegill in a three-acre pond having an average depth of one foot would be killed with the addition of 0.005 of a pound of Endrin. It was also found that some food organisms may be much less sensitive to Endrin than the fish themselves.

In order to expand our studies and secure a better water supply, we established a sub-laboratory at Corvallis, Oregon, in 1952. There we worked cooperatively with the Department of Fish and Game Management of Oregon State University. Dr. Doudoroff is in charge of this unit which is principally engaged in basic toxicological and physiological studies.

In studying the toxicity of pesticides, many repetitions have been made of the acute toxicity tests, and the results reported are generally the averages of a large number of determinations. It was realized that such tests do not indicate safe levels of the materials, and that long-term tests, where the materials are continually renewed, are needed to demonstrate the lower lethal levels. Further, it was realized that studies of the sub-lethal effects must be made if levels which are not harmful under conditions of continuous exposure are to be determined. As the program developed and the staff increased to some nine workers, methods for long-term flow-through studies were developed. Studies of thirty, sixty, to ninety days duration were carried out with selected species in order to determine some of the long-term or chronic effects of these materials. It became clearly evident that our staff facilities and funds were not adequate to meet the many problems arising with the growth of our population and industrial development. Public Health Service officials and conservation groups, seeing the need of such studies for the development of water quality criteria, actively pushed such a program and in August, 1962 Congress appropriated four million dollars for the construction of two water quality laboratories, one for fresh-water problems and one for marine problems.

Plans for these laboratories are now well advanced, and it is hoped that they will be completed in 1966. These laboratories will enable us greatly to expand the work now being carried on at the Robert A. Taft Sanitary Engineering Center Laboratory, Cincinnati, Ohio, at our Newtown Laboratory, and at our Corvallis Sub-station. In providing for these laboratories, Congress charged the Public Health Service with the responsibility for determining water quality criteria for all water uses with special reference to water quality criteria for aquatic life. Plans are now under way for such an expanded program.

Among the important problems which have to be met is that of toxic pest control materials. Pesticides are now being manufactured and used in such quantities in this country (over one billion pounds in 1962, two-thirds of which was synthetic organic materials), that they constitute an important water pollutant. This is clearly indicated by the Public Health Service annual survey of fish kills. In meeting these problems it is believed that two studies are essential: (1) we must determine the relation between the amount of a pesticidal material applied and that reaching the watercourse; and (2) we must determine the concentration of these materials in the water which are not harmful to aquatic life under conditions of continuous exposure. This latter will, of course, include the effects of concentration in the bodies of organisms. Data on both of these points must be available if we are to meet the pesticide problem and protect our aquatic resources. Research to obtain answers on the second problem, the determination of safe levels in the water, has been largely centered at my laboratory in Cincinnati.

In addition to the determination of safe levels in the water, we have been actively engaged in the development of methods for determining if safe levels have been exceeded. In short, we are interested in the development of autopsy techniques for the determination of the cause of fish kills.

C. M. Tarzwell

Some years ago a young man came to see me regarding a problem for his doctoral thesis. Since we had been studying Endrin, I suggested to him that the toxicity of Endrin to fishes, or to a specific species of fish would be a good problem for his doctoral degree. He accepted this suggestion and took as his problem the toxicity of Endrin to the fathead minnow. In the course of his studies he developed a new and improved method for the controlled deoxygenation of water. His thesis was outstanding, and was published by the Fish and Wildlife Service. Upon completion of his doctorate degree he joined our staff in spite of the fact that he had several other good offers. I feel that it was because he liked the way we conducted our research work and the opportunities afforded in the Public Health Service. Since we were continually urged by various State agencies to develop methods for the demonstration of the cost of fish kills, he was assigned the task of developing autopsy techniques for heavy metals. He began his work with zinc,and a paper has recently appeared outlining the methods for the determination of methods of fish kills due to zinc. Some time later he was placed in charge of our Newtown Laboratory, which is only a short distance from the Center. Here he has shown his initiative and ability in the development of facilities and methods for the carrying out of bioassay and the development of autopsy techniques. Recently he has devised a serial dilution pollution apparatus which greatly simplifies the provision of continual flows containing known concentrations of toxicants.

When we were called upon in late November 1963 to investigate the fish kills in the Lower Mississippi and determine their cause, I realized that this was a difficult problem, since investigations carried out during the past several years had not demonstrated their cause. It was decided, therefore, to send our most competent investigators to the area to see the fish kills at first hand. Mr. Tom Maloney and Dr. Donald Mount were the staff members selected for this task. It was decided that in meeting this problem we would attempt to take into consideration all possible causes which we could envision as being responsible for this fish kill. These men, therefore, were instructed to collect samples of the bottom materials which could be analyzed for toxicant, to collect and immediately freeze large numbers of dying fish, and take large numbers of blood samples from the dying fish and immediately freeze them so that they might be utilized in future studies. Studies of these samples were carried out at SEC. In approaching this problem, Dr. Donald Mount developed and used outstanding research techniques, and we feel that he and those working with him have carried out a classic research in clearly demonstrating that the levels of Endrin in the blood of the fish dying in the Mississippi were sufficient in themselves to account for the death of these fish. He has been very ably supported in this task by Dr. Mary Schafer. She is a widely recognized authority in the detection and determination of levels of pesticides in animal tissues. The Fish and Wildlife Service, several State agencies as well as various groups in the Public Health Service, have submitted samples to her for determination. Methods which she has developed have been no small factor in enabling us to solve the Mississippi River fish kill.

Investigations on the other main phase of the pesticide problem, namely, the relation between the amount applied and that reaching our water courses has been carried out from our Atlanta laboratories under the direction of Dr. H. P. Nicholson, with the able assistance of Dr. Alfred Grzenda.

In our analytical work, we have been very ably assisted by Dr. Mary Schaefer, who has made a great contribution to this effort. She is recognized as an authority on the extraction of these materials from flesh and the determination of them. She has received samples of materials from all over the country and has been quite successful in this line of work.

Now, there is also another group who figures in it, and this is our basic data people of the water quality network, and Dr. Breidenbach has headed up this group analyzing the materials in water.

The work of all these groups and individuals, when combined, constitutes a well rounded approach to the solution of the pesticide problem.

I feel that with our need to re-use water, those who use it must return it to the source in a condition so it is suitable for other uses. To do this effectively and efficiently, they must have some knowledge of the amounts which must not be exceeded.

In short, we do need some water quality criteria to designate what is safe for various uses of water. We must have teams of workers of this type if we are to meet our present problems.

Such research and investigation for the protection of our water resources and our water supplies are essential for ourselves and for the generations yet to come.

MR. STEIN: Thank you, Dr. Tarzwell.

Are there any comments or questions?

(No response.)

MR. STEIN: Dr. Tarzwell, I would just like to emphasize a couple of things you said.

1. I am glad to welcome you as an expert, as one of the few old-timers older than myself in the business. You look so young.

I know you are talking in terms of criteria studies and differential studies, and this, as you know, is what leads to results. But, as I understood your statement, you indicated that on the basis of your experience and in your opinion, pesticides or chlorinated hydrocarbons ran off from the fields when they were applied in doses which were toxic to fish. Is that correct?

DR. TARZWELL: That is correct.

MR. STEIN: And, as I understood you, you say that of these pesticides, Endrin is the most toxic substance to fish you ever tested. Is that correct?

DR. TARZWELL: That is correct.

MR. STEIN: Thank you, Dr. Tarzwell.

MR. SVORE: Mr. Chairman, I would next like to present Dr. Donald Mount, whom Dr. Tarzwell mentioned in his presentation.

Dr. Mount is a fisheries research biologist at the Basic and Applied Sciences Branch of the Public Health Service at Cincinnati, Ohio.

I will call on Dr. Mount. He will discuss the biological investigations of the 1963 Lower Mississippi fish kill.

STATEMENT OF DR. DONALD MOUNT, FISHERIES
RESEARCH BIOLOGIST, BASIC AND APPLIED
SCIENCES BRANCH, UNITED STATES PUBLIC
HEALTH SERVICE, ROBERT A. TAFT SANITARY
ENGINEERING CENTER, CINCINNATI, OHIO

DR. MOUNT: Mr. Chairman, conferees, and ladies and gentlemen:

For the record, Mr. Chairman, I would like to note an error in Table II. The first value should read "103.8."

MR. STEIN: From now on, I wish, if there are typographical errors in the material, that you would wait until you get to the table, and then call it to our attention.

Thank you.

D. Mount

DR. MOUNT: During the first week in December 1963, Mr. Thomas Maloney, an aquatic biologist from our section, and I went to Baton Rouge to investigate the fish kill that was occurring in the Mississippi River. We were briefed by Mr. Lafleur and staff as to the past history of the kills and after questioning various people and becoming acquainted with the facts we decided that the commonly measured chemical and physical conditions of the river such as dissolved oxygen and temperature were not the cause of the kills. We then accompanied the State personnel on one of their power boats and observed the dying fish in a section of the Mississippi River six to eight miles long, in the area of Baton Rouge, and in approximately five miles of a navigation canal leading off the Mississippi River, opposite Baton Rouge. Thousands of catfish, drum, buffalo and shad were seen at the surface, unable to maintain an upright position and often having convulsions. Literally acres of minnow schools were also in a state of hyperactivity and convulsions. The abdomens of nearly all of the dying catfish were distended and examination revealed that the stomach and intestines were filled with gas and liquids. In many fish there were hemorrhagic areas on the skin and internal organs. In every case the alimentary tract was devoid of any food material but the fish were not emaciated nor did

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they appear to be suffering from some chronic disease or long-term exposure to toxic materials.

Blood smears were made for differential blood counts and blood samples were drawn for future analyses. I worked in the boat cabin collecting blood samples while others netted the dying fish with hand nets. Fish were most easily obtained by following in the wake of tugboats. Apparently the stress placed on the fish by the wake caused the fish to convulse.

We spent one day on the delta in the area around Venice, an area approximately 235 miles below Baton Rouge. The previous menhaden kill was described to us by one of the Louisiana enforcement officers that had been in the area during the kill. At the time I was there, I observed menhaden, mullet and catfish, numbering in the thousands, in various stages of hyperactivity and convulsions. One blue catfish weighing an estimated 15 lbs. was floating in the Venice harbor, unable to maintain an upright position. On several occasions, we went into a dead-end canal and as the boat approached the end, schools of menhaden were trapped and hundreds of these fish began convulsing, jumping onto the boat, the banks and against an oil drilling rig.

A total of 25 blood smears were made for future analyses, tissues were preserved for histological examinations, blood samples were collected in vials and frozen immediately on dry ice, approximately 100 fish carcasses were placed on wet ice until they could be frozen in the laboratory, and samples of mud were collected. All samples were kept frozen on dry ice or in freezers after collection.

Initial Investigations at Cincinnati

After returning to Cincinnati, effort was directed towards establishing the general nature of the causative agent. Samples were given to Public Health Service bacteriologists for tests to determine the presence of botulism and other specimens were sent to the U. S. Fish and Wildlife Service to be checked for fish parasites or disease. Tissues of dying fish were analyzed for 19 metals using an emission spectrograph; cholinesterase levels in the brains were measured to determine if organic phosporus insecticides might be implicated. Tissues of dying fish were fed to healthy catfish to see if a viral or bacterial disease could be transmitted to healthy fish. All of these tests were negative.

Organic solvent extracts of the bottom muds were made. These extracts were then dissolved in water and small catfish were placed in the water. This was repeated three times, and each time convulsions, loss of equilibrium and distention of the abdomen were observed. Two laboratories examined fish specimens using a gas chromatograph and found several peaks including ones having retention times identical to Endrin and DDE. Two large peaks with retention times that did not correspond to any known insecticide were observed and were called X and Y for convenience.

I examined the blood preparations and sections of various tissues and discovered that the white cell counts were approximately 50 percent lower than those counts obtained from individuals of the same species collected from a small lake in Louisiana. Damage of the tubules in the kidney was extensive in dying fish. Hematocrits, which is the percent of cell volume to total blood volume, of dying and normal catfish were examined while I was at Louisiana State University and the hematocrits of the dying fish were approximately 50% below normal.

Numerous samples of various tissues from dying fish and control fish were analyzed on the gas chromatograph and the curves were compared. Blood was included in these comparisons. The materials that were found only in dying fish tissues were X, Y and a material tentatively identified as Endrin. My previous studies on the effects of Endrin on fishes, in continuous flow experiments lasting eleven months, indicated that Endrin was toxic to fish at water concentrations in the range of .3 to .5 p.p.b. The presence of Endrin in the blood at an estimated concentration of 400 p.p.b. seemed very significant. X and Y were extracted from muscle tissue, separated on the gas chromatograph, and were found to be relatively nontoxic when compared to the toxicity of Endrin collected from the same quantity of tissue.

Five different laboratories had confirmed Endrin in the tissue of dying fish. Because Endrin was present in every dying fish examined, tests were begun to establish the concentration of Endrin in blood after a lethal exposure. Blood was chosen as the best tissue in which to measure the critical concentration because the liquid portion of the blood bathes the brain and spinal cord constantly. Endrin is a central nervous system poison and so the blood concentrations of Endrin would be critical. The approach used in this work was to determine the concentration of Endrin in the blood at the time of death and in non-lethal exposure in laboratory tests, and then compare the concentrations of Endrin in the blood from dying fish and living fish collected in the Mississippi River. If the concentration of Endrin in the blood of dying river fish was as high as the concentration in the blood of fish killed by exposure to low concentrations of Endrin in the laboratory, we would be confident that Endrin killed the catfish in the Mississippi River.

At this point, I would like to say that the chemistry technique involved will be discussed by persons more qualified than myself in the next presentation.

Experimental Exposures

Channel catfish, weighing one-half to one pound, were obtained from a fish hatchery in Arkansas. They had been raised in well water and blood tests indicated only background concentrations of DDE. Approximately 75 fish were used in these tests. Testing was done in one of our test systems that has been in use for a period of three years. The exposure tanks were stainless steel troughs 6' x 1' x 1' with a water depth of 6"-7" and a continuous flow of water at 150 ml/min. A continuous flow of fresh water, containing the desired amount of Endrin, had to be maintained in order to remove waste products produced by the fish. Continuous flow must also be used in order to maintain the toxicant concentration, in this case Endrin. If a static test is used, that is, one that is not continuous-flow, fish may survive high concentrations of 10 p.p.b. or more, because they absorb most of the Endrin from the water but do not receive a lethal dose. It is common to find concentrations of Endrin killing fish in continuous-flow tests that are ten to fifty times lower than the concentration required to kill similar fish in static or non-renewed tests.

All water lines were glass except for plastic connections. The water used in these tests was from our standard laboratory reservoir. For this supply we run tap water through a 17 cu. ft. activated carbon filter and then into a 100,000 gallon outdoor concrete pool. The retention time is 90 days in this pool and during this period abundant quantities of plankton grow so that the water closely resembles a natural water. Enough deionized water is added, as needed, to maintain the total hardness between 100 and 150 p.p.m. expressed as calcium carbonate. The pH ranges from 7.8 to 8.0. The Endrin tests were conducted at 22° C, two degrees higher than the river temperature at the time the 1963 kill began. Work in our laboratory indicates that temperature affects the toxicity to a significant extent only in short-term tests of a few days' duration. Longer tests of 15 days or more are not temperature-dependent. Therefore, we did not deem it necessary to lower the test temperatures.

Blood samples were prepared in my laboratory in

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groups of six, and the extracts were sent to the chemists, and were labeled only with a code number. In alternate groups of six, duplicate samples were included, one of the duplicates containing a known quantity of Endrin. Table II lists the actual percent recoveries which range, except for one, from 84 to 103 percent. This is the point at which the error on Table II should be corrected. The chemists were able to analyze only six blood samples per day because four or five standards were interspersed among the blood samples in order to be sure that the standard curve or the retention time did not shift. On several occasions, samples were analyzed two or more times on different days and reproducibility was within five percent.

Experimental Results

Figure 1 and Tables I through IV contain the data from these exposures and data from fish collected in the waters of the Mississippi River and connected bayous. Channel catfish that died of Endrin poisoning in the laboratory displayed symptoms identical to those observed during the fish kill on the Mississippi River in December, 1963. Symptomatology included hyperactivity, convulsions, loss of equilibrium, hemorrhaging, and gas and liquid distention of the stomach and intestines.

Cellular damage in the kidneys of experimental exposed fish was apparently identical to the damage observed in dying fish tests.

May we have the slides now?

If you are unable to see the slides, you can refer to the figures in your printed text.

This slide (indicating) is a plot of the blood concentration expressed in parts per million against the time of exposure.

I call your attention to the fact that the exposure time is expressed on a logarithmic scale, and that the time involved between the first two numbered units is nine-tenths of a day, and between the next two is nine days, and, of course, ninety days between the last two.

You will see that in very short-term exposure, in the order of two hours or less, the blood concentrations were very high, in the range of 1.4 to 2 parts per million.

Now, these two values were in static tests. All of the rest of the values on this curve were in continuous-flow testing.

You will see that after we approached the approximately thirty hours of exposure time, just slightly over one day, that there seems to be a stability in the

Endrin concentration in the blood at the time of death.

Now, remember all of these fish with the closed black dots are dying fish. They were in their last stages of convulsions and loss of equilibrium.

You will see a few points at the bottom which are indicated by open circles. You will probably not be able to see that from your seats. These are values of fish that did not die.

Now, in the case of the ones being pointed to at the present time, these fish were at concentrations which subsequently would have killed the fish, and I also note here that there is one point that has been left out. You can find it in the table. It is a value of .23 parts per million.

Other values of living fish on the right you see were in the range of less than .2 parts per million.

Now, if we superimpose on this graph the range of concentrations in the blood of dying Mississippi River channel catfish, we see that the concentration in the blood of these dying river fish was clearly as high as the stable lethal threshold that we established in laboratory exposure for fish of the same species.

Again, if we superimpose on top of this the concentration range of Endrin in the blood of living

Mississippi River channel catfish collected late in February, at a time when a kill was not occurring, we see that the range is distinctly different from the range found in the dying fish; and, in fact, it is distinctly lower than the range of concentrations established for dying laboratory exposures.

Discussion of Results

From the data in Figure 1, it is clear that the concentrations of Endrin in the blood of dying fish are distinctly higher than in fish that were exposed to sublethal concentrations or in ones that had not been exposed long enough to die. It is also quite evident that the blood concentrations of Endrin in the dying channel catfish from the Mississippi River were as high or higher than the concentrations of Endrin in fatal exposures of laboratory fish. It is also apparent that, after approximately 30 hours of exposure, the concentration of Endrin in the blood at death does not increase or decrease with longer exposure times. My previous work has shown that death does not occur after two to four weeks so long as the Endrin concentration of the water does not change. This pattern of mortality, however, does not indicate acclimation to Endrin. For example, in one group of exposures a small increase in the Endrin concentration in the water after 21 days, produced death within 24 hours, indicating that no acclimation or increase in tolerance to Endrin had occurred.

Examination of the tables will also show that the concentrations of Endrin in the blood of channel catfish collected in February from the Mississippi River after the kill had subsided, were much lower than in the dying river fish. One will see also that buffalo, collected after the kill had subsided, did not have any detectable Endrin concentration in the blood. In short, the data show that when river fish were dying their blood contained a much higher concentration of Endrin than after the kill had ceased and that the concentrations of Endrin in the blood of dying channel catfish taken from the river were as high or higher than the lethal concentration for that species.

In recent work chemists have found that X and Y, the two previously unknown materials found in all dying river fish, are 1, 2, 3, 4, 7, 7-hexachloro-2, 5-norbornadiene and 1, 2, 3, 4, 5, 7, 7-heptachloro-2-norbornane, compounds believed to be intimately involved in the manufacture of Endrin. Screening tests indicate that the toxicity of Endrin is 1,000 to 10,000 times greater than the toxicity of X and Y. Concentrations of 100 to 300 p.p.b., and one value of 900 p.p.b. were found in the blood of dying channel catfish.

I emphasize the units again, parts per billion. Endrin was expressed in parts per billion.

Since these compounds are much less toxic and the concentrations in the blood are less than the lethal water concentrations, these levels in blood would not be considered lethal or highly toxic.

Other pesticides that were found in the blood of the dead fish were Dieldrin and DDE or DDT. Dieldrin was often absent but DDE was always present at concentrations very similar to those found in healthy fish from Ohio waters and waters in Louisiana other than the Mississippi River.

If most of the fish had not died from Endrin poisoning, the probability of collecting ten successive fish killed by Endrin would be remote. Furthermore, the probability of getting ten fish killed by Endrin would decrease rapidly as the fraction of the total kill caused by Endrin, decreased. For instance, if fifty percent of the fish were dying from Endrin poisoning the probability of consecutively picking up 10 fish with lethal levels of Endrin in their blood would be approximately one in a thousand. The chances if only 10 percent of the deaths were caused by Endrin would be one in ten billion. In fact, it is only when most of the fish are killed by Endrin that one would expect to pick 10 consecutive fish that were killed by Endrin.

It was noted without exception that every dying fish examined had excessive amounts of fat stored around the abdominal organs. In one case a buffalo, weighing approximately 8 pounds, yielded nearly 1 pound of such fat. In fact, the physical condition of all dying fish was excellent and there were no signs of chronic illnesses such as is often observed in fish diseases or from accumulative toxicity. Reflecting on these observations in light of the Endrin concentrations that were found, this situation is to be expected since in other studies, long experimental exposures of eleven months' duration to sub-lethal concentrations of Endrin did not cause a deterioration of general physical condition. The effect of Endrin is all or none insofar as mortality is concerned, that is, it kills quickly if it kills at all. This all or none effect, however, has been established for death only. The effects on reproduction have not been studied adequately, and it is quite possible that sub-lethal concentrations of Endrin may reduce seriously the reproduction of fishes.

The role of other chemicals must be considered in determining the cause of mortality. The laboratory studies have shown clearly, however, that there was more than enough Endrin in the blood to have caused mortality in the Mississippi River fish. Even though other toxicants were undoubtedly present in the river at low concentrations, the close relationship of blood-Endrin concentration to mortality, both in the field and in the laboratory, is clear and convincing. This, coupled with the duplication of symptoms in the laboratory, including hemorrhaging, distention of the stomach, and similar kidney damage, leaves little doubt about the cause of mortality. There was no degeneration of internal tissues and the low white blood cell counts further substantiate the conclusion that death was not due to bacterial diseases. Viral diseases can also be disregarded because tissues of dying fish, fed to healthy fish, failed to transmit an infection. If this kill had been due to disease, it would have to have been a highly contagious disease and, therefore, would have been easily transmitted in such feeding tests.

Summary Points

1. Laboratory studies have shown that there is a clear difference between the blood concentration of Endrin in living and dying channel catfish.

2. Dying Mississippi River catfish had concentrations of Endrin in the blood equal to or higher than fish of the same species that were killed in laboratory exposures to Endrin.
3. The symptoms of the dying fish were identical in both the river fish and the laboratory exposures.
4. Cellular damage in the kidneys of the dying river fish was similar to the kidney damage caused by chlorinated hydrocarbons.
5. Disease (including virus), heavy metals, organic phosphorus compounds, dissolved oxygen, and pH were all eliminated as causal agents.

Conclusion

My conclusion is that the fish kill in the winter of 1963-64 in the Lower Mississippi River was the result of Endrin poisoning.

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TABLE I

Blood concentration of endrin in channel catfish in laboratory exposures.

Sample No.	No. Fish	Water Concentration ppb	Exposure Time	ppm in Blood
3/13-6	1	40.0	2.4 hr., dead	1.40
2/27-5	1	40.0	2.4 hr., dead	1.98
2/27-1	1	10.0	5 hr., dead	1.20
2/27-2	1	10.0	5 hr., dead	0.70
3/9-11	1	10.0	6 hr., dead	0.95
3/9-10	1	10.0	6 hr., dead	0.86
3/9-9	1	10.0	7 hr., dead	0.89
3/5-1	1	5.0	32 hr., dead	0.31
3/4-1	1	5.0	33 hr., dead	0.46
3/19-3	1	5.0	33 hr., dead	0.50
3/4-4	1	4.0	48 hr., dead	0.36
3/3-4	1	4.0	48 hr., dead	0.26
3/4-3	1	2.5	48 hr., dead	0.27
3/3-3	1	2.5	48 hr., dead	0.31
3/3-5	1	2.5	70 hr., dead	0.34
3/5-2	1	1.6	13 days, dead	0.39
3/11-10	1	1.2	96 hr., alive	0.23
3/3-6	1	1.2	96 hr., alive	0.16
3/9-8	1	1.0	15 days, dead	0.44
3/9-12	1	0.6	96 hr., alive	0.10
3/5-3	1	0.6	96 hr., alive	0.12

TABLE I (Cont'd.)

Sample No.	No. Fish	Water Concentration ppb	Exposure Time	ppm in Blood
3/13-2	1	0.5	21 days, alive	0.13
3/13-3	1	0.5	21 days, alive	0.14
3/13-5	1	0.25	21 days, alive	0.10
3/15-4	1	0.25	21 days, alive	0.13
4/2-4	5	1	21 days, dead	0.24
4/2-5	1	1	9 days, dead	0.42
4/2-6	1	1	11 days, dead	0.23
4/14-1	5	0.0	44 days, alive	0.00
4/14-2	4	0.06	44 days, alive	0.06
4/14-3	5	0.12	44 days, alive	0.07
4/14-4	5	0.25	44 days, alive	0.07
4/14-5	2	0.50	44 days, alive	0.19
3/11-7	1 Buffalo Ohio River	2.0	48 hr., dead	0.22

TABLE II

Percent Recovery of Endrin from Blood

Sample No.	Percent Recovery
3/13-1	303.8
3/11-3	96.3
3/9-1	89.0
3/5-4	88.0
3/3-1	93.8
3/27-4	Spilled
2/22-5	60.0
2/10-6	100.0
4/2-2	84.3

TABLE III

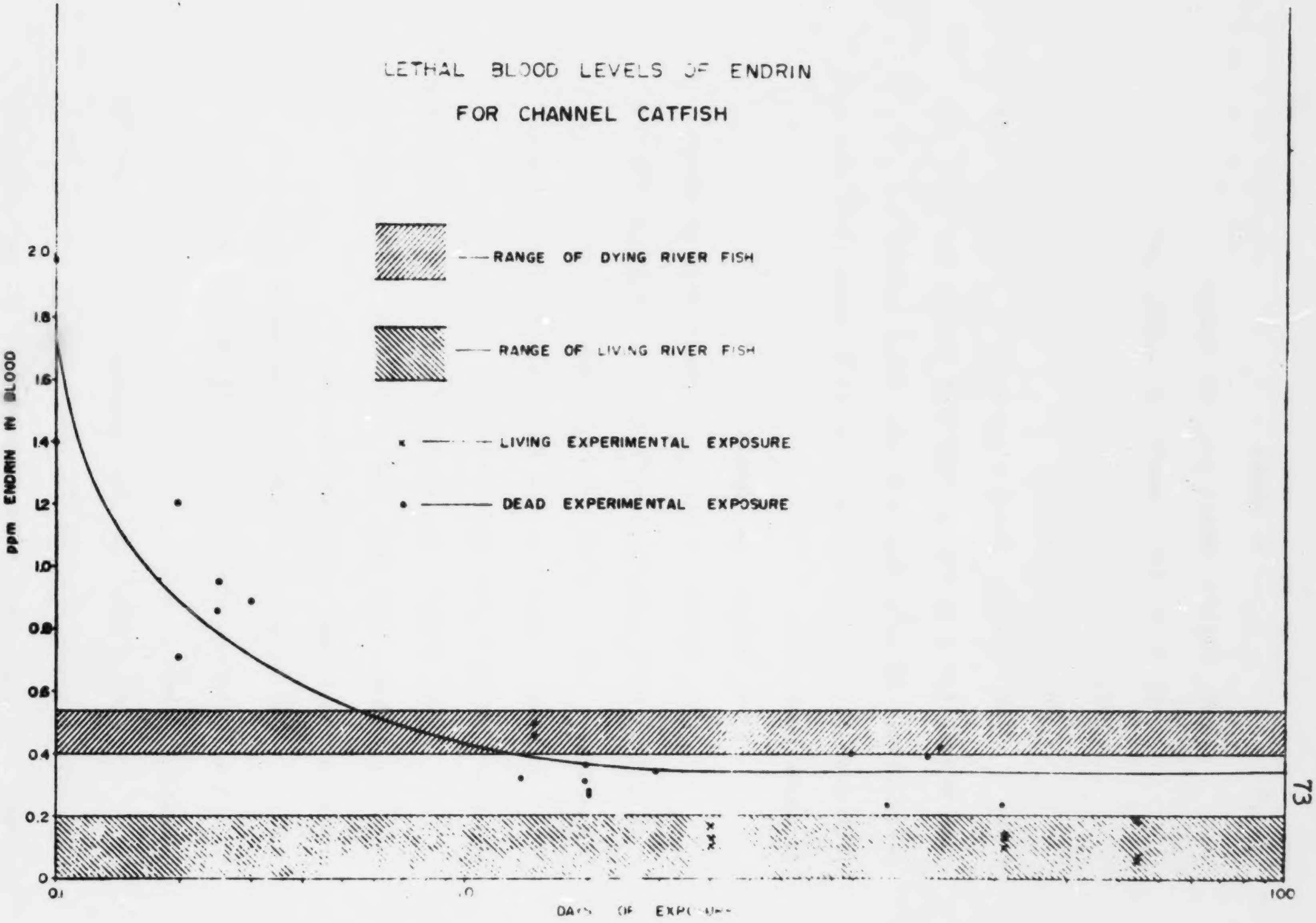
Blood concentration of endrin in dying Mississippi River Fish

Sample No.	No. Fish	Species	ppm Endrin in blood
2/19-3	1	Channel catfish	0.41
2/20-4	4-6	Channel catfish	0.40
1/31-6	1	Channel catfish	0.56
2/19-4	1	Bullhead	0.16
2/20-3	1	Blue catfish	0.26
2/20-1	1	Buffalo	0.14
2/19-6	1	Buffalo	0.12
2/19-2	Approx. 10	Shad	0.22
2/19-1	Approx. 10	Shad	0.15

TABLE IV

Blood concentration of endrin in living Mississippi River Fish collected in February and March 1964.

Sample No.	No. Fish	Species		ppm Endrin in blood
3/11-8	6	Channel catfish		0.14
3/11-9	7	Channel catfish		0.21
3/11-12	8	Channel catfish		0.20
3/11-6	3	Channel catfish		0.11
3/11-5	6	Channel catfish		0.04
3/9-2	1	Channel catfish		0.17
3/9-3	1	Channel catfish		0.08
3/9-4	2	Channel catfish		0.08
3/5-6	1	Channel catfish		0.09
3/11-11	7	Bullhead		0.06
3/11-4	3	Bullhead		0.05
[illegible]-2	2	Buffalo		None
[illegible]5	3	Buffalo		None
[illegible]	3	Buffalo		None
2/22-1	4	Channel catfish	LSU Lake	None
2/22-2	20	Sunfish	Bayou Pidgeon	None
2/22-3	-	Channel catfish	Lake Kilarney	None
2/22-4	-	Channel catfish	Bayou Pidgeon	<0.08
2/22-5	2	Channel catfish	Arkansas Hatchery	None
2/27-3	2	Channel catfish	Arkansas Hatchery	None
3/4-2	1	Channel catfish	Ohio River	None


LETHAL BLOOD LEVELS OF ENDRIN
FOR CHANNEL CATFISH
RANGE OF DYING RIVER FISH
RANGE OF LIVING RIVER FISH
LIVING EXPERIMENTAL EXPOSURE
DEAD EXPERIMENTAL EXPOSURE
ppm ENDRIN IN BLOOD
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0.1
1.0
100
DAYS OF EXPOSURE

MR. STEIN: Thank you, Dr. Mount.

Are there any comments or questions?

MR. JONES: Murray?

MR. STEIN: Yes.

MR. JONES: Going back here to Page 2 on this fish mortality, I am not as familiar as you are with salt water fish. We only have one salt water stream in Tennessee, but these five million salt water fish, were most of those menhaden?

MR. STEIN: Dr. Mount?

DR. MOUNT: I can only answer that question from what I have been told by others. I did not observe the menhaden kill, but my opinion would be that it is.

MR. JONES: In the tests run on the menhaden, did you pick up Endrin and Dieldrin?

DR. MOUNT: The menhaden that were dying at the time I was there were very small and very few in number, and we did not take any blood samples.

We observed a number of menhaden that were having convulsions and were hyperactive, but we did not tak samples of these. No.

MR. JONES: Do you conclude from this that the fish were picking this up off the bottom or out of the water? I have heard this discussed in the agricultural hearings.

DR. MOUNT: I have not made any conclusion about where the Endrin is coming from.

There will be data presented later today which will show some of the water concentrations, but these will be minimum water concentrations and not actual water concentrations. Therefore, I don't think we can say at this point that the evidence points either way about the source of Endrin, as far as the fish toxicity is concerned.

MR. JONES: So, out of the 5,175,000 fish, about 5,000 were the menhaden then in 1963?

DR. MOUNT: Mr. Lafleur could answer that question better than I, or Mr. Biglane.

MR. STEIN: Would you try that question again?

MR. JONES: Yes. In 1963 -- is that the 1963-1964 kill you referred to?

DR. MOUNT: Yes. My conclusion refers to the 1963 kill.

MR. JONES: Back on Page 2, we are talking about 5,175,000 fish, of which 5,000,000 were the salt water variety.

Were most of those the menhaden?

MR. LAFLEUR: Yes. The vast majority of the salt water fish were menhaden.

MR. JONES: What percent were catfish of these fresh water fish, roughly?

MR. LAFLEUR: I don't know, but a very small percentage.

MR. JONES: Ten? Twenty? Thirty?

MR. LAFLEUR: Less than that.

MR. JONES: All the tests were run on catfish then, weren't they?

DR. MOUNT: I am not sure that he understood your question. You said "fresh water" in regard to catfish. Did you mean that, or did you mean salt water?

MR. JONES: We have fresh water cats in Tennessee.

DR. MOUNT: What I am saying is the answer to that question would be different if you are referring to the catfish kill in fresh water.

MR. JONES: Put it both ways. Of the 5,000,000 there, you meant a small amount of cats then?

MR. LAFLEUR: In the salt water area.

MR. JONES: How about the fresh water?

MR. LAFLEUR: The large majority of them would be catfish.

DR. MOUNT: This was the reason for using catfish in our exposure, because at the time I was there, it was the species most readily affected.

MR. JONES: Are yours with both salt water and fresh water cats?

DR. MOUNT: No, sir. These were channel catfish that the laboratory experiments were done with.

MR. WOOD: How do you account for the lack of acclimatizing in this case? Isn't it rather unusual for fish not to become acclimated to hydrocarbons?

DR. MOUNT: Other than the work of Dr. Ferguson at Mississippi, I know of no work that has been done in this regard, and I think that we must be very careful in drawing conclusions about 36-hour experiments and in tabulating them to two weeks, or four weeks.

MR. STEIN: Are you satisfied, Mr. Wood, or do you want to pursue that?

MR. WOOD: That is all right.

MR. STEIN: Are there any other comments or questions?

(No response.)

MR. STEIN: Before you leave, Dr. Mount, I don't know that I have a question, but I think Mr. Jones raised an interesting point.

So that the people here will understand this possibly, or maybe see the way I understand it, according to Mr. Biglane, he had a rather close correlation, for example, with aerial applications of pesticides called Endrin, where fish mortalities would occur soon after a rain, and mortalities ceased when aerial applications of Endrin ceased for the year.

I think we have a situation there, as I understand it from Mr. Biglane's statement, where Endrin in the upper canebrakes or upper reaches of the river possibly may be connected with mortality, and the mortality was instant. However, I think what Dr. Mount is saying is that in places where you have extremely low concentrations of Endrin, such as a place where you find a vast amount of dilution water in the lower Mississippi River, we also have cases of mortality. These cases of mortality are connected, in his opinion, with Endrin, and he says it was the result of Endrin poisoning.

However, the symptomatology, as I understand it, of the fish dying here, was different. These fish did not die instantly, but they had convulsions, distended abdominal tracts, and sometimes hemorrhaging.

As I understand this again, Dr. Mount reproduced this situation in the laboratory, and to his practiced eye as an aquatic biologist, he saw the fish have the same symptoms.

This question, of course, will be a fascinating one, but I think we might as well, as I see it, outline the question here as propounded by Mr. Jones.

I am not saying that Endrin killed the fish, but if it killed the fish, the question is where did the Endrin come from? I certainly don't know yet, and I have no conclusion, but this I think we can postulate: That the fish must get Endrin from their total environment.

In other words, Endrin is not found naturally in the Mississippi River. The fish don't go out to a supermarket or drug store or a package store and buy it.

The point I think we have to make is that but for man and the manufacture, sale and distribution of Endrin, Endrin would not be in the Mississippi River, and the fish cannot get their Endrin other than in the Mississippi River.

I think this is the question that has developed so far, and is something to which we should direct our attention.

Would you say this is a fair statement, Dr. Mount?

DR. MOUNT: Yes, sir.

MR. STEIN: If there are no further questions, thank you very much, Dr. Mount.

MR. SVORE: Mr. Chairman, our next speaker was also referred to by Dr. Tarzwell.

I would like to introduce Dr. Mary Schaefer, Research Chemist in the field of food chemistry and milk and food research in our Division of Environmental Engineering and Food Protection at Cincinnati, Ohio, at the Taft Sanitary Engineering Center.

She will present the assay methods used to determine chlorinated hydrocarbons in blood and other fish tissues for Lower Mississippi studies.

Dr. Schaefer.

STATEMENT OF DR. MARY SCHAEFER, RESEARCH CHEMIST, FOOD CHEMISTRY, MILK AND FOOD RESEARCH, DIVISION OF ENVIRONMENTAL ENGINEERING AND FOOD PROTECTION, ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO

DR. SCHAEFER: Mr. Chairman, conferees, ladies and gentlemen:

A gas chromatograph equipped with an electron capture detector was used for the assay of chlorinated hydrocarbons in tissue extracts and blood of dying fish from the Lower Mississippi River and fish exposed to known concentrations of Endrin.

M. Schaefer

This type of detector has been in use less than four years. It was first described by Lovelock and Lipsky in a paper published in the January 1960 issue of the Journal of the American Chemical Society. Since the fall of 1961 the Food Chemistry Laboratories at SEC have used this detector for the assay of chlorinated hydrocarbons in milk and other foods.

The things I am going to say about these studies apply to the studies on DDT. We find it also in Endrin.

A method developed in the Food Chemistry Laboratories for the detection of DDT in milk was published in the October 1963 issue of the Journal of Dairy Science. With only minor modifications, this method proved to be applicable for the assay of several chlorinated hydrocarbons in the tissue and blood of dying fish. Some of the advantages of the method include the following:

(1) The detector is so sensitive to halogenated hydrocarbons that a 10 gram sample can be assayed for minimum concentrations of 10 to 40 p.p.b. without the need of a concentration step;

(2) the detector is so specific that very little sample preparation is required and thus it is possible to complete an assay in a given sample

in about one hour;

(3) the precision of the method for DDT or Endrin at a level of 40 to 120 p.p.b. is ±3 p.p.b.;

(4) the accuracy of the method can be demonstrated with recoveries of 95% ± 8%.

At present there are six gas chromatographs equipped with e. c. detectors in the Food Chemistry Laboratories at SEC. Four of these are equipped for routine work using the method described here and two are being used for method development work.

Although the method was developed for the assay of DDT in milk, it has been found to be applicable for the assay of a wide variety of media including all types of food material, air filters, fish tissue and blood. With only minor modifications in instrumental conditions it was made useful for the simultaneous assay of Aldrin, TDE, DDE, Dieldrin and Endrin in a given sample. Using this method, over 100 different samples have been assayed during the past three months for studies concerned with the causative agent in the Mississippi fish kill.

The following is a brief description of the instrumental conditions and extraction procedure used in this method. I thought a slide might help. These (indicating) are the general components of a gas chromatograph. I thought it might be easier to talk from this. The coiled part there in the center is the column and it is the heart of a gas chromatograph.

With a gas chromatograph a mixture of compounds is resolved because of the individual absorption characteristic of each component on a stationary liquid phase. The liquid phase, used in this method, was a silicone grease plus an Epon Resin. This was coated on an inert solid support, a granular teflon material, and then packed in an aluminum tube, 1/4 inch in diamter. A 6-foot length is sufficient to resolve the commonly used chlorinated hydrocarbons. The column was held at 210°C. The moving phase was nitrogen gas. Hexane extracts of the biological media containing chlorinated hydrocarbons were injected into the moving phase at a temperature of 225°C so that instantaneous volatilization occurred. We maintain a flow rate of about 110 milliliters per minute.

As the chlorinated hydrocarbons are eluted from from the column at characteristic times they pass into the detector. The electron capture detector used in these studies has parallel plate geometry. It has a radioactive source, tritium, which ionizes the nitrogen carrier gas. A small potential is put across the electrodes, and the collection of the electrons at the anode produces a current in the micromicro ampere range. This current flow in the presence of carrier gas is suitably amplified and appears on the recorder as the base line. When a material capable of capturing electrons enters the detector it causes a decrease in the total number of electrons collected at the anode and the decreased current flow causes a negative peak on the recorder.

I will show you a sample of the chromatograph in just a minute.

The second slide now.

MR. STEIN: Can we have these available for the record for reproduction?

DR. SCHAEFER: Yes, sir.

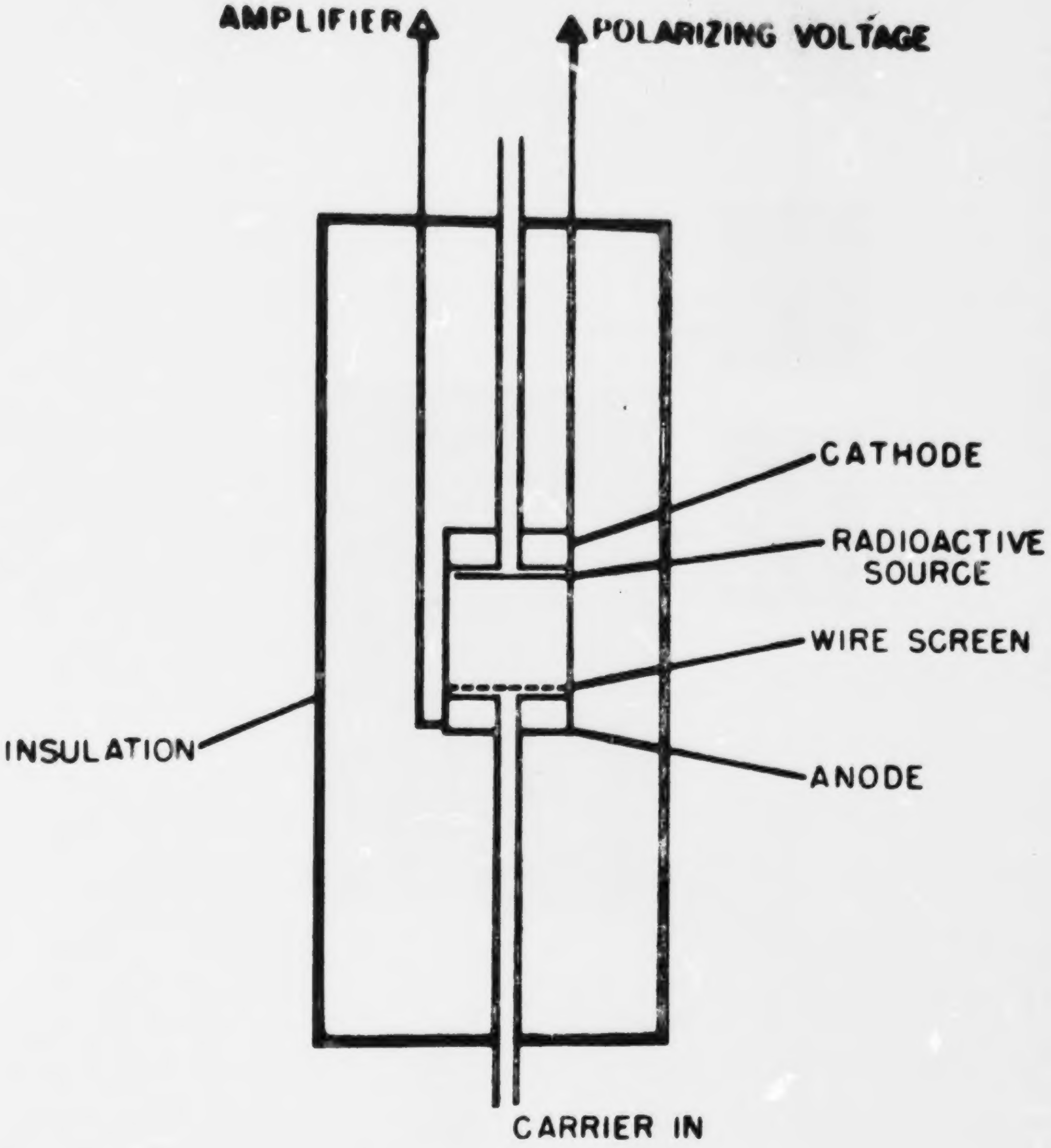
MR. STEIN: They will appear, as you know, in black and white on the record.

DR. SCHAEFER: Yes.

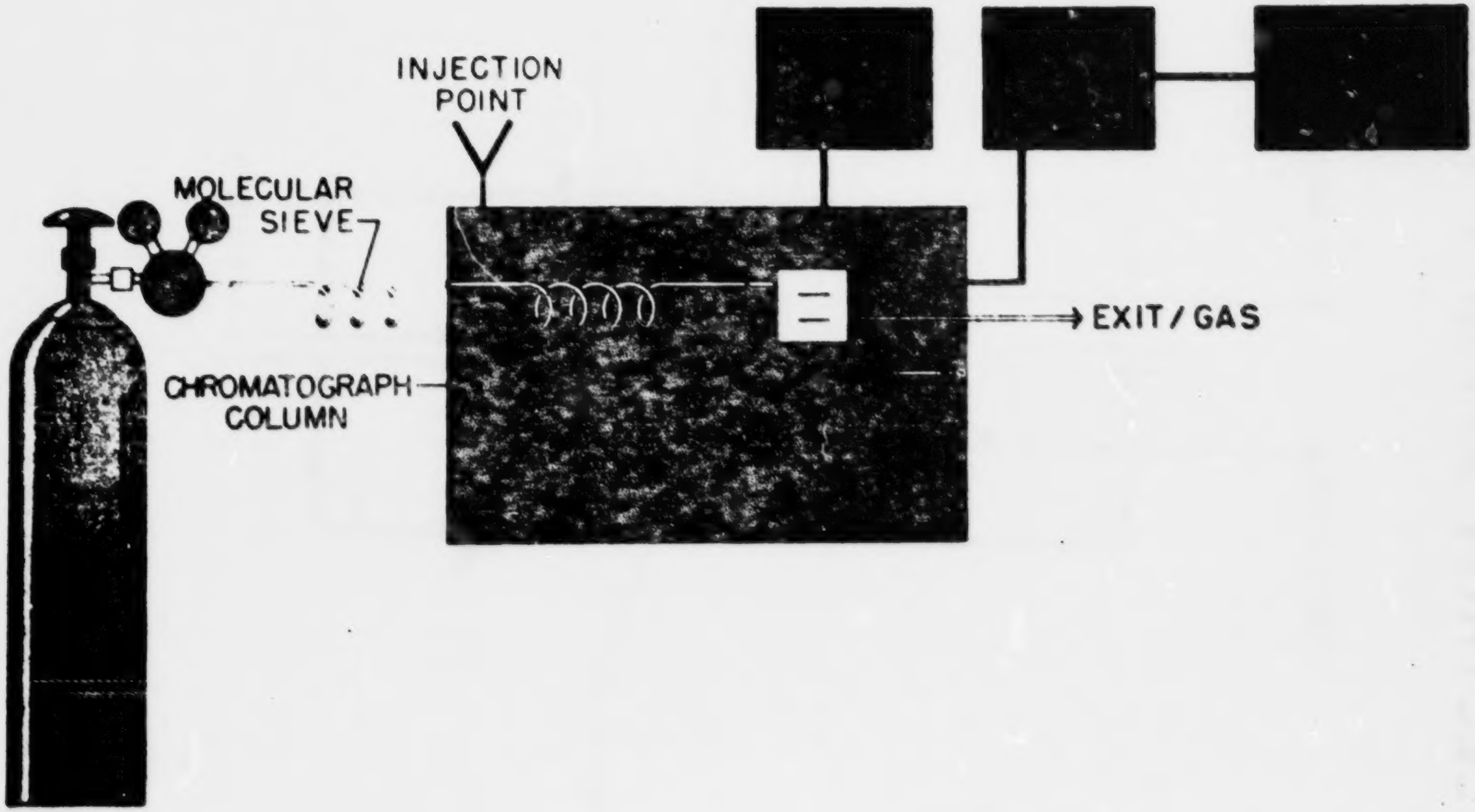
This (indicating) is a schematic diagram of the detector which we use. It is said to have parallel plate geometry. It has a cathode, an anode, the radioactive source is tritium, and the tritium ionizes the nitrogen carrier gas. The electrons produced then are collected at the anode when a small potential is put across the electrodes. We use about 35 volts for the potential across the electrodes.

84a

ELECTRON AFFINITY DETECTOR


AMPLIFIER
POLARIZING VOLTAGE
CATHODE
RADIOACTIVE SOURCE
WIRE SCREEN
INSULATION
ANODE
CARRIER IN

COMPONENTS OF GAS CHROMATOGRAPH


INJECTION POINT
MOLECULAR SIEVE
CHROMATOGRAPH COLUMN
EXIT / GAS

M. Schaefer

The electrons collect and the anodes produce a current in the range of the micromicroampere range. This current flow is the base line which we referred to on a recorder representation of a gas chromatograph.

The next slide now is a typical gas chromatograph (indicating). Over on the left side, if you can see, it is marked "Base Line." This would be the amount of flow from the electrons from the carrier gas, and the accumulation of the electrons at the anode from the carrier gas. In the presence of a material capturing electrons, there is a decrease in the amount of electrons collected at the anode and a decrease in the current flow.

We then see these peaks. These peaks are characteristic of the elution of the compound, which will show you the outline of the first two.

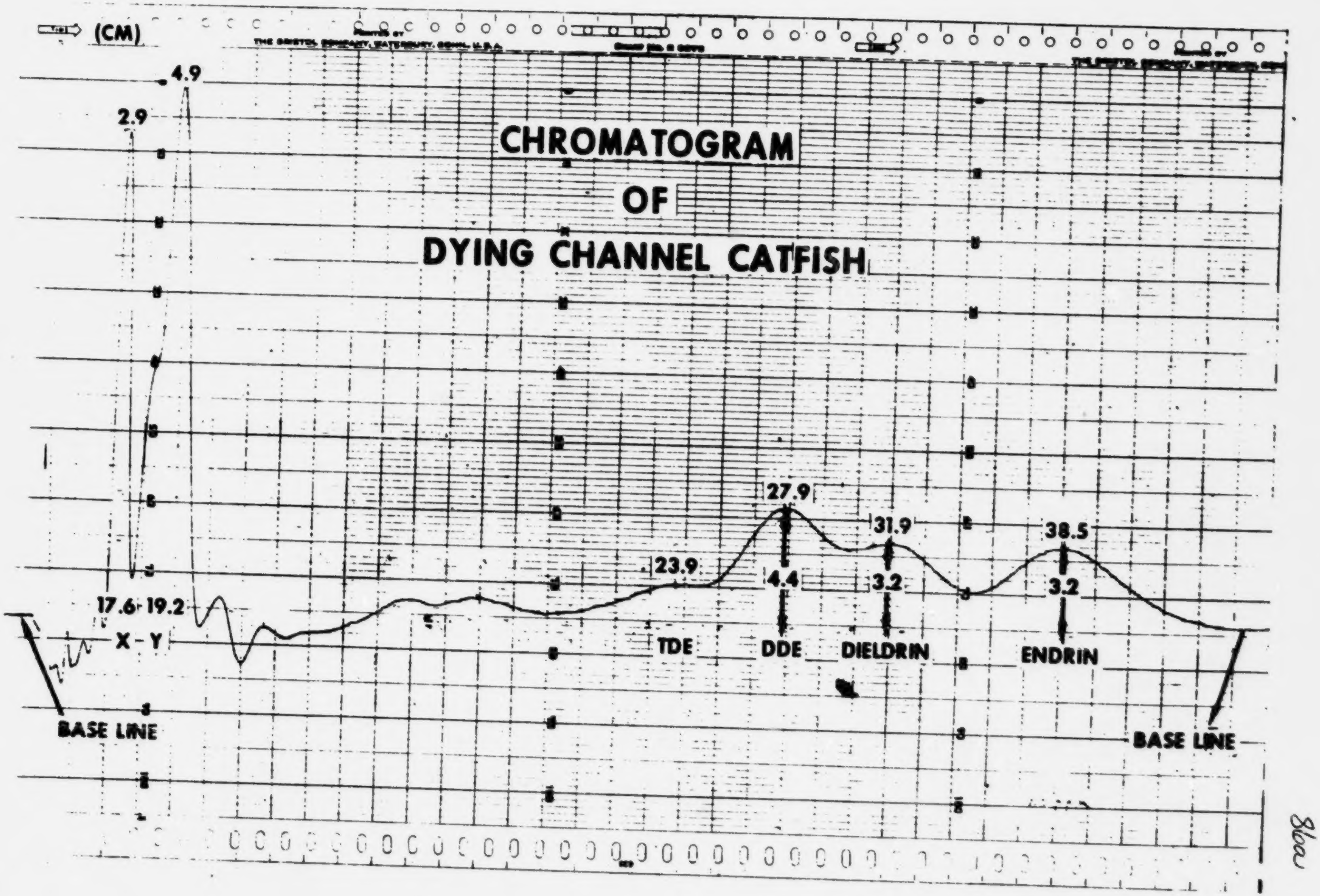
I will come back and discuss that a little bit later on the different compounds we eluted. I thought you might just like to see a general chromatograph.

The height of each peak is a measure of the concentration of each compound present and the time required for elution is used for identification. Calibration curves were prepared by plotting peak height versus concentration. For example, with Endrin, the calibration curve is linear for concentrations between 1 and 8 nanograms (10-9 grams) and peak heights between 1 and 3 centimeters.

Only compounds capable of capturing electrons give a response to this detector. Chlorinated hydrocarbons fall into this category. Although fats are incapable of capturing electrons they interfere with the maintenance of a stable base line and must be separated from the pesticides before they are chromatographed. This is accomplished in this method by hydrolyzing the fat to fatty acids and then extracting the pesticides with an organic solvent. Also water, even the extremely small amount present in a hexane solution saturated with water, must be removed for the maintenance of the stable condition required for routine work. In our laboratory the sample is dried in the following way. A six-inch segment of aluminum tubing, 1/4 inch diameter, is packed with CaC2 and attached to the column in such a way that the injected hexane extracts pass through it before reaching the column. As the injections pass through this column the water is converted to acetylene. Non-saponifiables such as the pigments also may cause bare line fluctuations and are removed by adding charcoal to the hexane extract of the pesticide. Due to the specificity of the detector most biological media contain no other interfering substances.

The extraction procedure used in our laboratory is as follows: a 10-gram portion of a homogeneous sample is

CHROMATOGRAM OF DYING CHANNEL CATFISH



combined with 20 ml of alcoholic KOH (25% w/v). After 15 minutes on a steam bath this is cooled and extracted with 10 ml. hexane.

A "pinch" of activated carbon is added, the container is swished to mix and then set aside until the charcoal has settled and the hexane layer is clear. Then a 50-microliter aliquot of the hexane extract is injected directly into the gas chromatograph.

A typical chromatogram of muscle tissue from dying fish taken from the Mississippi River shows several compounds capable of capturing electrons. In gas chromatography, these individual compounds are identified by comparing each retention time with that for standard solutions of known compounds. On this basis, DDE and Endrin were identified in the chromatograms of all fish tissue and blood of dying fish from the Mississippi River area. The DDE represents the total concentration of DDT and DDE in the samples since the DDT is converted to DDE during alkaline hydrolysis. In addition, all of the samples contained two components with very short retention times that are referred to as X and Y. Some of the samples of the dying fish also contained TDE and Dieldrin. No samples of fish from any area other than the Mississippi River contained detectable amounts of X and Y.

It has not been possible to degrade Endrin to X and Y by any known chemical technique. In the exposure studies described by Dr. Mount, no detectable levels of X and Y were observed. Thus, they do not appear to be metabolites of Endrin. Only one sample of technical Endrin has been found that contained either X or Y. This sample was about 10 years old and contained small amounts of Y. When this was discussed with the scientists from the Shell Chemical Company, they postulated the identify of X and Y and sent to the Sanitary Engineering Center samples of heptachloronorbornene and hexachloronorbornadiene, raw materials used in the synthesis of Endrin. These compounds had retention times identical to X and Y on our gas chromatograph.

For additional verification of the identify of X, Y and Endrin in the extracts and blood of fish from the Mississippi River, a collaborative study was set up with three other Public Health Service laboratories and one industrial laboratory. Hexane solutions containing a mixture of the hexachloronorbornadiene and the heptachloronorbornene and hexane extracts of muscle tissue from a dying fish from the Mississippi River were sent to the participating laboratories. Each of the laboratories verified that the three compounds in the fish extract were identical with Endrin and the two raw materials believed to be used in the synthesis of Endrin.

Fish from Arkansas were used for the laboratory studies concerned with exposures to known levels of Endrin. When received at the Sanitary Engineering Center the blood samples of these fish contained measurable amounts of DDE, (DDT plus DDE). They contained no detectable amounts of Dieldrin, X, or Y.

For these laboratory exposure studies Dr. Mount saponified the blood samples at the Newtown laboratories and delivered the hexane extracts to the Food Chemistry Laboratory under a code so that there would be no bias in our judgment concerning the presence or absence of X, Y and Endrin. This gave additional confidence to our observation that all samples of dying fish from the Mississippi contained X, Y and Endrin, while the laboratory exposed fish contained Endrin but no detectable levels of X and Y.

Recovery studies were run either on a biweekly basis or weekly basis. For these, a standard hexane solution of Endrin was added to the blood before saponification and extraction. Then the concentration of Endrin in these extracts was compared with the concentration known to be added, and that found in the samples before they were contaminated. Recovery studies remained at a quantitative level during this study.

In summary, a newly developed method was used for the assay of chlorinated hydrocarbons in the tissue and blood of dying fish from the lower Mississippi River and suitably chosen control fish. This method, using a gas chromatograph equipped with an electron capture detector, was developed for the assay of DDT in milk. Statistical analyses of the precision and accuracy of the method using a 10-gram sample indicate $\pm$ 3 ppb in the 40-120 ppb range and 95% $\pm$ 8% recoveries.

Using this method over 100 different samples of extracts and blood of fish were assayed between December 20, 1963, and April 1, 1964. All samples of dying fish from the Lower Mississippi River contained Endrin along with two raw materials used in the synthesis of Endrin, a hexachloronorbonadiene and a heptachloronorbornene. To this date it has not been possible to produce these raw materials from Endrin either in vivo or in vitro. They have not been found in fish, food or other biological media from any other geographic area.

MR. STEIN: Thank you, Dr. Schaefer.

Are there any comments or questions?

MR. WOOD: Yes, Murray.

MR. STEIN: Yes.

MR. WOOD: The chlorinated fractions account for a pretty small percent of the recovered organics in the Mississippi River carbon filter station.

I was wondering if any other detectors had been used to separate and identify any other hydrocarbons that aren't responsive to the electron capture detector?

DR. SCHAEFER: Yes, sir. The speakers later will talk about other methods. We happen to have only electron capture in our laboratory, so I have talked about that.

MR. WOOD: Was there any evidence of compounds which are also highly responsive to the electron capture detector method, but which are not hydrogenated hydrocarbons?

DR. SCHAEFER: The way we have checked this is comparing the microcoulometric data with the data from the electron capture detector, and we find a correlation -- for instance, a percent in the X and Y areas, and the Endrin area, as compared with the electron capture. These have been checked.

Is that what you mean, sir.

MR. WOOD: Yes. You get in effect a simple ratio of chlorine to hydrocarbon?

DR. SCHAEFER: These have been checked with the microcoulometric techniques. This will be described to you.

MR. WOOD: Was there any indication of any compounds having identical retention times with chlorinated hydrocarbons that you found?

DR. SCHAEFER: We do not know of any.

We have also verified the Endrin by other techniques, by infrared. This work I did not do in the laboratory. This will be reported by other workers.

MR. WOOD: Thank you.

MR. STEIN: To follow up on that question, I think with most of the fish you got in the laboratory, that Dr. Mount dealt with in the laboratory, you deliberately added Endrin. This was the substance he added.

MR. WOOD: It was spiked.

MR. STEIN: Not only spiked, but in lethal doses. In other words -- and I am trying to arrive at an approach to your question -- presumably in a fish taken from the Mississippi River, you might say, is there another substance that has another peak. The likelihood may be there, but in the laboratory Dr. Mount took about 100 fish and he put certain varieties of Endrin in there and spiked these operations. That was the thing that always indicated the peak, which was the Endrin peak. It seems to me that if this was the substance Dr. Mount put in, it seems to indicate that that might be corroborative.

MR. WOOD: That is true, but I was wondering about the possibility of a normal produced hydrocarbon that might follow through the extract procedure and might also have a similar retention time.

MR. STEIN: Go ahead, Doctor.

DR. SCHAEFER: In the collaborative study we did in comparing these three for retention times, the other laboratories used different column packages. There would be different characteristic retention times. One used, for example a column where there was degradation of the Endrin to produce two materials. They were still receiving the same degradation product from the extract as from the standard solution of Endrin.

Some of the other laboratories used the column conditions.

MR. WOOD: Did any of them use stainless steel columns?

DR. SCHAEFER: They used glass columns. To my knowledge, they didn't use stainless steel columns.

MR. STEIN: Is there any question or comment from anyone?

MR. JOHNSTON: I wonder, were any tests made on the fish that were picked up in the brackish waters, or were these just fresh water fish?

DR. SCHAEFER: Dr. Mount could answer that.

MR. STEIN: Is Dr. Mount available?

DR. MOUNT: Yes.

MR. JOHNSTON: Were any of these tests made on fish picked up in the brackish waters, or were all of the fish examined fresh water fish?

DR. MOUNT: If you will look at your Table No. I. I believe you will see a value for a polluted catfish. This is a 15-pound catfish that I referred to in my text as having been found in Venice Harbor.

Other than that, we did not do any Endrin analyses on marine forms. Of course, this is not a marine form either, I don't believe. However, it does live in brackish water. It was in the area.

We did do a blood smear study on marine fish. We did do histological examinations on marine fish.

Does this answer the question?

MR. STEIN: All right. Thank you, Dr. Mount.

Are there any further questions?

(No response.)

MR. STEIN: Well, thank you very much, Dr. Schaefer.

for coming. We certainly appreciate it.

MR. SVORE: Thank you, Dr. Schaefer.

Next, Mr. Chairman, I would like to call on Dr. Breidenbach, Chief of Technical Operations and Acting Chief of the Organic Chemistry Laboratory.

MR. STEIN: I would ask the people who have already made statements, such as Dr. Mount and Dr. Schaefer and Dr. Tarzwell and Mr. Biglane, to be available just in case any of the subsequent statements by the Federal participants or others might impinge on theirs, so that if there is any point that needs clarification we may have you up here to provide that.

Thank you.

Dr. Breidenbach?

STATEMENT OF DR. ANDREW W. BREIDENBACH,
CHIEF, TECHNICAL OPERATIONS, AND ACTING
CHIEF, ORGANIC CHEMISTRY LABORATORY,
BASIC DATA BRANCH, WATER POLLUTION SURVEILLANCE SYSTEM, UNITED STATES PUBLIC
HEALTH SERVICE, ROBERT A. TAFT SANITARY
ENGINEERING CENTER, CINCINNATI, OHIO

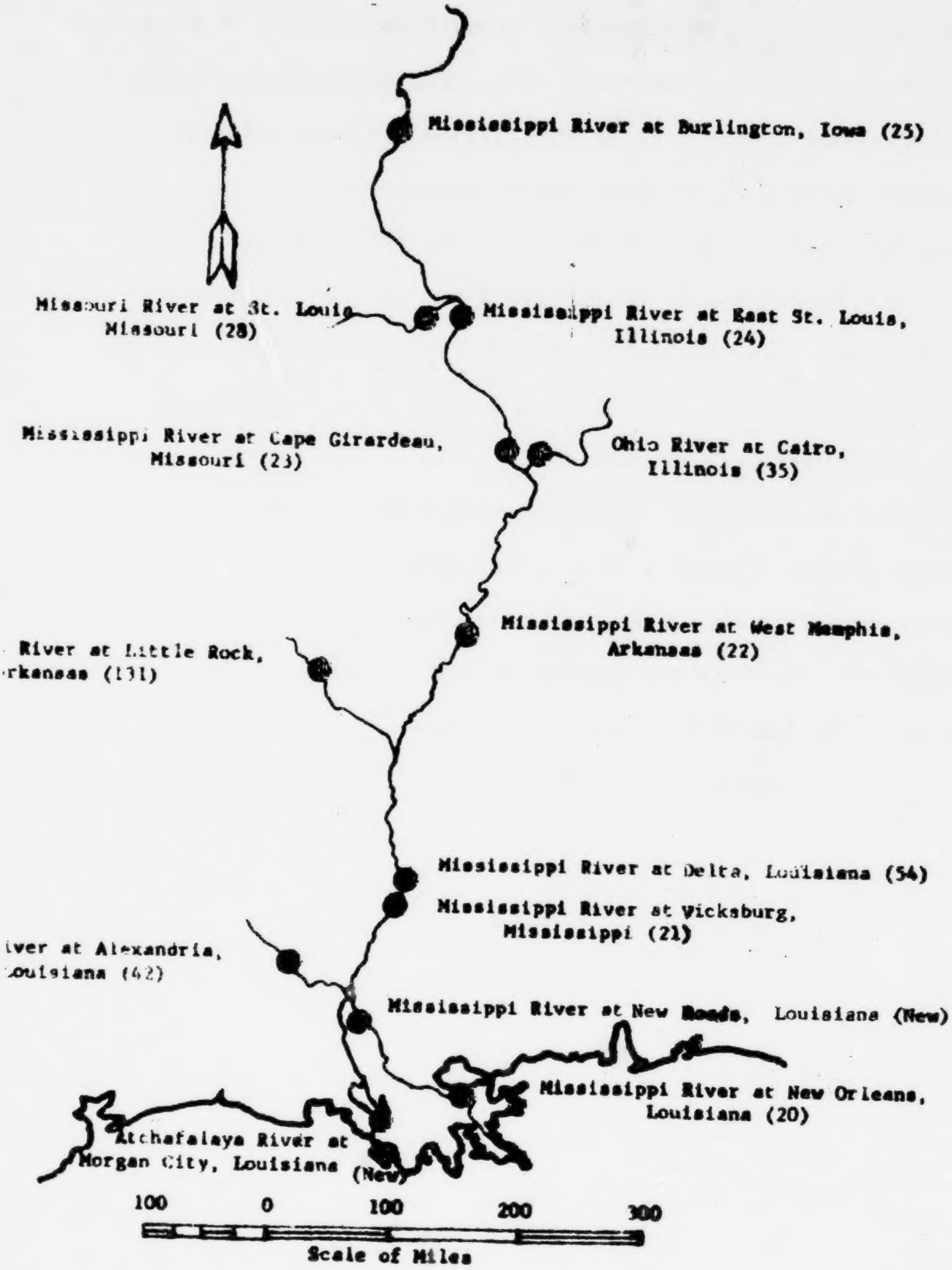
DR. BREIDENBACH: Mr. Chairman, conferees, ladies and gentlemen:

I represent the Public Health Service Water Pollution Surveillance System, which had been called formerly the National Water Quality Network. This system includes 130 surface water sampling stations, which are spread geographically over the country, and also includes modern water pollution laboratory facilities at the Robert A. Taft Sanitary Engineering Center in Cincinnati.

The Public Health Service Water Pollution Surveillance System was established in October 1957 to implement Public Law 660, as later amended, wherein the Secretary of the Department of Health, Education, and Welfare was authorized to collect and disseminate basic data on chemical, physical and biological water quality insofar as such data relate to water pollution, prevention, and control. Eight of the fifty surveillance stations established in 1957 were located on the Mississippi River main stem. The Surveillance System was expanded at the rate of 25 stations per year until it reached a total of 122 stations in September 1962. Six sampling stations were added during the following year. Two sampling stations have been established in 1964 in the Lower Mississippi River Basin, one at New Roads, Louisiana, on the Mississippi main stem and one at Morgan City, Louisiana, on the Atchafalaya. There are now a total of 130 sampling stations in the Public Health Service Water Pollution Surveillance System. Figure I is a map showing the location of pertinent stations. Other maps which define the location of additional stations are located in the appendix, as is descriptive information for each station.

(Figure I is as follows:)

SELECTED SAMPLING STATIONS
MISSISSIPPI RIVER AND TRIBUTARIES
FOR WATER POLLUTION SURVEILLANCE SYSTEM


Mississippi River at Burlington, Iowa (25)
Missouri River at St. Louis
Missouri (28)
Mississippi River at East St. Louis,
Illinois (24)
Mississippi River at Cape Girardeau,
Missouri (23)
Ohio River at Cairo,
Illinois (35)
Mississippi River at West Memphis,
Arkansas (22)
River at Little Rock,
rkansas (131)
Mississippi River at Delta, Louisiana (54)
Mississippi River at Vicksburg,
Mississippi (21)
iver at Alexandria,
ouisiana (42)
Mississippi River at New Roads, Louisiana (New)
Mississippi River at New Orleans,
Louisiana (20)
Atchafalaya River at
Morgan City, Louisiana (New)
100
0
100
200
300
Scale of Miles

A. W. Breidenbach

Participants in the Public Health Service Water Pollution Surveillance System include more than 175 State, local, and Federal water, sewage, or other public utilities, health departments, industries, universities, State water pollution agencies, and resident engineers of Federal reservoirs. Active local participation is important in this operation. The State and local agencies perform most of the conventional chemical analyses and collect various water samples for the more complex examinations. The Public Health Service performs the more complex determinations at its Cincinnati laboratories and makes the results available to the various participants. The program as a whole is designed to assemble, examine, and interpret the facts which enable water pollution control agencies and others concerned to determine the scope and character of problems to be solved. Specifically, the objectives of the Public Health Service Water Pollution Surveillance System may be set forth as follows:

A. To maintain continuous intelligence on the nature and extent of pollution affecting water quality.

B. To determine trends in water quality as affected by (a) water pollution control activities, (b) water resource development activities, and (c) water use and reuse.

C. To provide data on water quality useful in the development of comprehensive water resources programs.

D. To provide data which will guide State, interstate and other agencies in their water pollution control programs, and in the selection of sites for legitimate water uses.

E. To provide data of likely importance to epidemiological and toxicological studies.

Sampling locations are selected with the assistance of the various State and local agencies concerned, and each sampling station satisfies one or more of the following criteria:

A. Major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other legitimate uses.

B. Interstate, coastal, and International boundary waters.

C. Water on which activities of the Federal Government may have an impact.

The analytical work of the Surveillance System is devoted to characterization of surface water samples in six broad disciplinary areas. These are biological, microbiological, radiological, general chemical, as well as physical properties and synthetic organic chemicals. Frequency of collection of the various discrete samples varies from once per week to once per month depending on the type and purpose of the sample.

II

SAMPLING AND ANALYTICAL SURVEILLANCE OF THE MISSISSIPPI RIVER AND TRIBUTARIES

A. General

This report describes the program of the Surveillance System for the determination of synthetic organic chemicals and, more specifically, chlorinated hydrocarbon pesticides, such as Dieldrin and Endrin, in the Mississippi River and its tributaries. The technics employed in the Surveillance System use the carbon adsorption method as a basic tool. Carbon adsorption samples are collected monthly as an integral part of the Water Pollution Surveillance System program.

The usual sanitary type chemical and physical analyses are not satisfactory for measuring synthetic organic contaminants. The carbon adsorption method is one wherein a measured amount of water is passed through a column of activated carbon at a controlled rate. Synthetic organic material in the water is adsorbed on the carbon surfaces. The carbon is shipped to laboratories in Cincinnati where it is processed to remove the adsorbed material from the carbon. The carbon adsorption method is used as a means of collecting from a very large water sample, synthetic organic material for further identification by a variety of analytical methods.

Adsorption and desorption efficiencies to and from the carbon by the many synthetic organics available today are widely variable. For this reason it is very possible, and highly probable, that the concentrations of pesticides calculated from analysis of substances adsorbed on carbon are minimum concentrations. True concentrations may indeed be greater by an order of magnitude.

Because of the extremely low concentrations of pesticides which ordinarily have been found in surface waters, the carbon adsorption method has been an invaluable tool for collecting a large enough sample to permit the irrefutable identification of Endrin in Mississippi River water by several corroborative analytical methods. Further, the quantitative measurement of low levels of pesticides in much smaller, i.e., one liter, grab-type, samples of river water, was effected at the part per trillion level with confidence once the presence of these substances had been established irrefutably with other definitive and corroborating analytical methods.

B. Summary of Technic Employed to Detect, Identify and Quantitate Chlorinated Hydrocarbon Pesticides in Water

Carbon adsorption samples are obtained by pumping one to five thousand gallons of river water through a 3" x 18" pyrex glass cylinder filled with activated carbon at a flow rate of one-half gallon per minute. Organic substances are retained on the carbon. At the conclusion of the sampling run the cylinder containing the now wet carbon is shipped to the Water Pollution Surveillance System laboratories in Cincinnati, where the carbon is dried and extracted (washed) with double distilled chloroform to remove and concentrate the mixture of organic materials originally present in the river water. These substances, collectively called the carbon chloroform extract, are carefully separated from one another with the various forms of chromatography. Chromatographic analysis, which has been alluded to by Dr. Schaefer, is based upon the ability of an adsorbent, when exposed in a specific manner to a mixture of substances, to resolve the components of the mixture into individual substances or less complex groups of substances. From the carbon chloroform extract, a fraction is obtained by column chromatography, which includes compounds having an aromatic nature and usually chemically constructed of one or more rings made of carbon atoms. Most chlorinated hydrocarbon pesticides, as well as many other aromatic compounds, find their way into this fraction because of their aromatic nature. The aromatic fraction is separated further by thin layer chromatography which permits the isolation of the pesticide in relatively pure form in a discrete spot on a glass plate coated with a thin layer of white silica gel. In this step the position of the spot, now visible because it has been sprayed with a detecting reagent, is an important factor in the identification of the pesticide. The presumptively identified pesticide from a replicate but non-sprayed spot is removed from the silica gel and examined by microcoulometric titration and electron capture gas chromatography. The gas chromatographic tests are used to corroborate and quantitate the original presumptive identification by showing that the presumptively identified chlorinated hydrocarbon pesticide (a) contains chlorine, (b) behaves in identical fashion to a known pure standard substance and (c) is present in a finite amount.

The aromatic fraction, originally obtained from the carbon chloroform extract, is also examined by infrared spectrophotometric methods which provide the most definite information for identification purposes.

The determination of chlorinated hydrocarbon pesticides in liter-sized samples is begun by extracting all of the water in the sample, as well as the glass bottle container, with a solvent such as hexane. In view of the very low concentrations which must be examined in water the results are checked with these several independent methods in which the chlorinated hydrocarbon pesticide is highly and preferentially soluble.

A. W. Breidenbach

There is an error on this page which I will have to correct. The hextane extract is concentrated, and then this extract is subjected to thin layer chromatography in the same manner in which the aromatic fraction was subjected to thin layer chromatography when we dealt with the carbon chloroform extract.

The thin layer cleaned up fraction now is then subjected in identical fashion to microcoulometric titration gas chromatography and to electron gas chromatography, and in view of the low concentrations which must be dealt with in river water, we elect to corroborate these identifications with the several methods.

Once the pesticides and other organic materials are in the solvent, the volume of the solvent is reduced by evaporation and as a result the pesticides in the solvent become concentrated. Using a portion of the concentrated extract, the pesticides are separated, as previously, in relatively pure form by thin layer chromatography and a presumptive identification is made. Definitive identifications are made in a manner identical to that described for the carbon adsorption samples, the chlorinated hydrocarbon pesticides being reclaimed from the thin layer chromatographic plate and examined with electron capture and microcoulometric titration gas chromatography. In view of the very low concentrations these results are corroborated by these several methods.

III

RESULTS OF ANALYSIS

A. Current Levels of Chlorinated Hydrocarbon Pesticides - Carbon Adsorption Method

The results of all quantitatively reportable analyses for pesticide concentrations obtained with the carbon filter method from stations on the Mississippi River and its tributaries are given in Tables I-1 through I-22.

A summary of the results I can present now in the form of Chart No. 2.

For those of you who cannot see this, this is also at the rear of the report that has been reproduced.

These results cover a period from July 1963 through March 1964. The data show that Endrin was rarely present.

A summary of the carbon adsorption results for Endrin and Dieldrin during the period July 1963 through March 1964 is presented in Table II (Chart 2). The data show that Endrin was rarely present in quantifiable amounts at stations upstream from West Memphis; its presence is much more apparent at West Memphis and all stations downstream on the river during the nine month period. The highest value for Endrin was recorded at West Memphis during the September 30-October 14 period - 0.214 p.p.b., and the next highest value - 0.140 p.p.b. -- was noted in December, during the period of the fish kill, at New Orleans.

May we have the next chart, please?

The Dieldrin results shown in Table II (Chart 3) present a different pattern. A maximum concentration, which could not be shown on this map, of 0.067 p.p.b. was found at the Dubuque, Iowa, station, with lower maximum values recorded at downstream stations until the West Memphis sampling point is reached, where the maximum concentration found during this period was 0.058 p.p.b. The maximum result obtained at the Vicksburg, Mississippi, and Delta, Louisiana, sampling points was 0.022 p.p.b. and less than the maximum observed at West Memphis. It was also less than the maximum value obtained at New Orleans -- a value of 0.034 p.p.b.

The samples analyzed from WPSS stations on three major tributaries to the Mississippi River, and the Red River indicate negative amounts or nonquantifiable traces of Endrin entering the Mississippi and Atchafalaya Rivers from these sources. Measurable quantities of Dieldrin were observed in all of these tributaries except the Arkansas.

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To supplement the carbon adsorption data available for enumeration of current levels of pesticide pollution, a series of grab samples were taken on the Mississippi main stem, the Atchafalaya and certain tributaries to these streams.

May I have the next chart, please?

These streams were at high flow levels. The results of the analyses of these samples are presented in Table IV (Chart 4). These results are quantitative and are considered to be directly representative of the levels of the pesticides contained in the respective samples and do not represent minima as do the carbon adsorption method results.

Endrin was not found in these series of grab samples from the Mississippi, the Atchafalaya or their direct tributaries.

Dieldrin, however, was found in the sample from the Big Black River. Endrin as well as Dieldrin was found in a sample obtained from the Nonconnah Creek Drainage Canal, which discharges into McKellar Lake, which, in turn, discharges into the Tennessee Chute, a direct tributary of the Mississippi River. The Tennessee Chute discharges to the Mississippi River south of Memphis below the PHS Water Pollution Surveillance System station at West Memphis, Arkansas.

B. Historical Levels of Chlorinated Hydrocarbon Pesticides - Carbon Adsorption Method

As was previously outlined, a monthly sampling frequency for obtaining carbon adsorption samples has been the practice since the PHS Water Pollution Surveillance System was inaugurated in 1957. The carbon chloroform extracts from such samples have been stored in the surveillance system bank, if you can call it that, and it was possible to analyze a limited number of these extracts for Endrin and Dieldrin for a historical perspective for this conference.

These extracts, I might point out, were examined very recently with methods that have been available to us only for about seven months.

In this limited amount of time, one historical sample of CCE from the low-flow month of each year 1958-1963 was analyzed for each of three Water Pollution Surveillance

System stations on the Mississippi main stem. Although these 18 results, which constitute only 10 percent of potentially available results from these stations, cannot be considered to provide a complete delineation of the historical occurrence of Endrin they do supply significant information.

The results of analyses for Endrin of carbon adsorption samples taken in the low-flow months of 1958, 1959, 1960, 1961, 1962 and 1963 are presented in Table III (Chart 5), which is on the screen now. The data show that Endrin was present in the Mississippi River as early as 1958. At the West Memphis Surveillance station, Endrin was present in quantifiable amounts during the low-flow months of 1958 through 1963 except for 1961. The data suggest it was present in sharply increased concentrations in the 1963 low-flow month. At New Orleans Endrin was present in 1958 and in 1960 through 1963 at periods of low flow. In 1960, 1961, and 1962 the apparent concentration of Endrin in the samples from New Orleans was greater than the concentrations from the low-flow months samples analyzed from the two upstream stations. However, in 1963 the relationship was reversed since the apparent concentration at West Memphis was almost three times greater than that at New Orleans in the respective low-flow months.

It is concluded that the data herein establish the presence of Endrin in quantifiable amounts in the Mississippi River in the area covered by the conference from November 1958 through March 1964, and suggests significant sources of Endrin above and below the Water Pollution Surveillance System station at West Memphis, Arkansas.

TABLE I

The following multi-page table includes data on the identification of pesticides at selected Water Pollution Surveillance System stations having carbon adsorption sampling equipment.

Table I Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Concentration values are calculated from quantitative gas chromatographic analysis of the aromatic fraction. In light of the unknown efficiency of carbon adsorption sampling for these compounds, the reported values represent minima, the actual values being equal to, or greater than the values reported.

* Asterisk indicates less than the amount shown

- Dash indicates negative.

Table I-2. Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Mississippi River @ Dubuque, Iowa

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	18 07 08 01	8 10 3	8 15		1	11	-	.067	*.001	-	-	-
-	18 07 08 01	9 04 3	9 17		1	11	-	*.001	*.001	-	-	-
-	18 07 08 01	10 07 3	10 14		1	11	-	*.001	*.001	-	-	-
-	18 07 08 01	3 02 4	3 09		1	11	-	.001	-		-	*.001

Table I-3. Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Mississippi River @ Burlington, Iowa

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	18 07 11 01	8 05 3	8 13		1	11	-	.001	*.001	-	-	-
-	18 07 11 01	9 02 3	9 19		1	11	-	*.001	*.001	-	-	-
-	18 07 11 01	10 07 3	10 15		1	11	-	.001	*.001	-	-	-

Table I-4. Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Mississippi River @ East St. Louis, Illinois

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	16 07 18 04	8 20 3	8 26		1	11	-	.003	*.001	-	-	-
-	16 07 18 04	9 17 3	9 23		1	11	-	.003	*.001	-	-	-
-	16 07 18 04	10 08 3	10 16		1	11	-	.001	*.001	-	-	-
-	16 07 18 04	2 04 4	2 06		1	11	-	.001	-		-	

Table I-5 Chlorinated Hydrocarbon Pesticide determinatic from carbon adsorption raw water sample

Water Pollution Surveillance System

Mississippi River @ Cape Girardeau, Missouri

SAMPLE	LOCATION	BEGIN	END	RPT	TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
373	28 07 22 02	11 03 8	11 17	4 23 4	1 11	-	.004	.013			
819	28 07 22 02	10 08 9	10 14	4 23 4	1 11	-	*.001	-	*.001		*.001
1363	28 07 22 02	10 04 0	10 17	4 23 4	1 11	-	*.001				
1911	28 07 22 02	8 07 1	8 21	4 23 4	1 11	-	.010	-		.002	
2789	28 07 22 02	9 06 2	9 17	4 23 4	1 11	-	*.001	-		-	
-	28 07 22 02	8 05 3	8 19		1 11	-	.005	.007	-	-	-
-	28 07 22 02	9 03 3	9 11		1 11	-	.003	*.001	-	-	-
-	28 07 22 02	10 07 3	10 21		1 11	-	.001	*.001	-	-	-
-	28 07 22 02	11 04 3	11 12		1 11	-	.002	-	-	-	-
-	28 07 22 02	1 06 4	1 20		1 11	-	.001	-	-	-	-
-	28 07 22 02	2 03 4	2 17		1 11	-	.001	-	-	-	-

Table I-6 .nlorinated Hydrocarbon Pesticide determinatio from carbon adsorption raw water samples

Water Pollution Surveillance System

Mississippi River @ West Memphis, Arkansas

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
370	04 10 06 01	11 05 8	11 17	4 23 4 1 11	-	.002	.004		-	
887	04 10 06 01	11 23 9	12 04	4 23 4 1 11	-	.002	.002		-	
1343	04 10 06 01	10 03 0	10 10	4 23 4 1 11	-	.002	.007			
1965	04 10 06 01	9 11 1	9 20	4 23 4 1 11	-	.004	-		.001	
2874	04 10 06 01	10 09 2	10 16	4 23 4 1 11	-	.002	.006			-
-	4 10 06 01	8 13 3	8 20	1 11	-	.002	.019	-	-	-
-	4 10 06 01	9 03 3	9 09	1 11	-	.015	.026	-	-	-
-	4 10 06 01	9 30 3	10 14	1 11	-	.058	.214	-	-	-

Table I-7. Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Mississippi River @ Delta, Louisiana

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	21 10 11 01	7 01 3	7 08		1	11	-	.022	.022	-	-	-

Table I-8. Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Mississippi River @ Vicksburg, Mississippi

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	27 10 11 02	8 05 3	8 15		1	11	-	.005	.020	-	-	-
-	27 10 11 02	9 09 3	9 18		1	11	-	.004	.020	-	-	-
-	27 10 11 02	10 09 3	10 18		1	11	-	.003	*.001	-	-	-
-	27 10 11 02	2 10 4	2 19		1	11	-	.007	.039		-	-

Table I Chlorinated Hydrocarbon Pestic ae .eterminat .s from carbon adsorption raw water samp.

Water Pollution Surveillance System

Mississippi River @ New Orleans, Louisiana

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
319	21 10 21 01	9 09 8	10 08	4 23 4	1	11	-	*.001	.001		-	
805	21 10 21 01	9 30 9	10 07	4 23 4	1	11	-	*.001	-			
1382	21 10 21 01	10 17 0	10 24	4 23 4	1	11	-	.014	.064		-	
1945	21 10 21 01	9 05 1	9 13	4 23 4	1	11	-	.006	.029		-	-
2747	21 10 21 01	8 20 2	8 27	4 23 4	1	11	-	.015	.160			-
-	21 10 21 01	8 05 3	8 08		1	11	-	.013	.074	-	-	-
-	21 10 21 01	9 06 3	9 12		1	11	-	.032	.082	-	-	-
-	21 10 21 01	9 13 3	9 20		1	11	-	.024	.083	-	-	-
-	21 10 21 01	10 02 3	10 08		1	11	-	.007	.060	-	-	-
-	21 10 21 01	10 10 3	10 15		1	11	-	.011	.134	-	-	-
-	21 10 21 01	10 23 3	10 28		1	11	-	.034	.054	-	-	-
-	21 10 21 01	11 19 3	11 24		1	11	-	.005	.019	-	-	-
-	21 10 21 01	12 09 3	12 14		1	11	-	.015	.140	-	-	-
-	21 10 21 01	2 07 4	2 11		1	11	-	.015	.102	-	-	-
4428	21 10 21 01	2 19 4	2 24	4 17 4	1	11	-	.012	.066			

Table I-10. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples
Water Pollution Surveillance System

Missouri River @ Kansas City, Kansas

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE

Table I-11 Chlorinated Hydrocarbon Pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Missouri River @ St. Louis, Missouri

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD
	28 09 12 10	10 13 8	10 27		1	11		.003	-	-	-
	28 09 12 10	8 15 3	8 30		1	11		.004	-	-	-
	28 09 12 10	9 15 3	9 30		1	11		.003	-	-	-
	28 09 12 10	10 15 3	10 30		1	11		.002	-	-	-
	28 09 12 10	11 15 3	11 29		1	11		.002	-	-	-
	28 09 12 10	12 16 3	12 31		1	11		.002	-	-	-

Table I-12. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Arkansas River @ Little Rock, Arkansas

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
4 10 10 03		3044 3	10		1	11		*.001	*.001	.005	.001	.001

Table I-13. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Red River @ Alexandria, Louisiana

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
21 10	16 01	6 4 3	6 12	4 27	4	1 11		.001	*.001			

Table I-14. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Ohio River @ Toronto, Ohio

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE

Table I-15. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples
Water Pollution Surveillance System

Ohio River below Addison, Ohio

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
69*										

Table I-16. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Ohio River @ Huntington, West Virginia

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE

Table I-17. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Ohio River @ Cincinnati, Ohio

SAMPLE	**LOCATION**	**BEGIN**	**END**	**RPT TY MAT**	**ALDRIN**	**DIELDRIN**	**ENDRIN**	**DDT**	**DDD**	**DDE**

Table I-18. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Ohio River @ Louisville, Kentucky

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE

Table I-19.
Chlorinated hydrocarbon pesticide determinations from
carbon adsorption raw water samples
Water Pollution Surveillance System

Ohio River @ Evansville, Indiana

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE

Table I-20. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples
Water Pollution Surveillance System

Ohio River @ Cairo, Illinois

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	16 05 21 12	8 18 3	8 29	1 11	-	.001	-	-	-	-
-	16 05 21 12	9 16 3	9 27	1 11	-	.016	-	-	-	-
-	16 05 21 12	1 24 4	1 28	1 11	-	.003	-	-		-
-	16 05 21 12	2 19 4	2 24	1 11	-	.002		-		

Table I-21. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples

Water Pollution Surveillance System

Tennessee River @ Lenoir City, Tennessee

SAMPLE	LOCATION	BEGIN	END	RPT	TY	MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	47 04 08 06	8 15 3	9 01		1	11	-	.004	-	-	-	-

Table I-22. Chlorinated hydrocarbon pesticide determinations from carbon adsorption raw water samples Water Pollution Surveillance System

Tennessee River @ Pickwick Landing, Tennessee

SAMPLE	LOCATION	BEGIN	END	RPT TY MAT	ALDRIN	DIELDRIN	ENDRIN	DDT	DDD	DDE
-	47 04 08 05	6 17 3	6 24	1 11	-	-	-	.011	-	-
-	47 04 08 05	9 11 3	9 17	1 11	-	.003	-	-	-	-
-	47 04 08 05	1 24 4	1 27	1 11	-	.002	-		.006	
-	47 04 08 05	2 17 4	2 18	1 11	-	.003	-	-	.004	.001

Table II

Range of Concentration of Endrin and Dieldrin at Selected Water Pollution Surveillance System Stations on the Main Stem of, and Tributaries to, the Mississippi River - 7/63 to 3/64 - Carbon Adsorption Method.

Station No.	River	Location	No. of Samples	Concentration* Range in ppb Endrin	 Dieldrin
27	Mississippi	Below St. Paul, Minn.	3	<0.001 - <0.001	<0.001 - 0.001
26	Mississippi	Dubuque, Iowa	4	<0.001 - <0.001	<0.001 - 0.067
25	Mississippi	Burlington, Iowa	3	<0.001 - <0.001	<0.001 - 0.001
24	Mississippi	East St. Louis, Ill.	4	neg** - <0.001	0.001 - 0.003
23	Mississippi	Cape Girardeau, Mo.	6	neg** - 0.007	0.001 - 0.005
22	Mississippi	West Memphis, Tenn.	3	0.019 - 0.214	0.002 - 0.058
54	Mississippi	Delta, La.	1	0.022 - -	0.022 - -
21	Mississippi	Vicksburg, Miss.	4	<0.001 - 0.039	0.003 - 0.007
20	Mississippi	New Orleans, La.	10	0.019 - 0.140	0.005 - 0.034
28	Missouri	St. Louis, Mo.	7	neg** - neg**	0.001 - 0.004
131	Arkansas	Little Rock, Ark.	1	<0.001 - -	<0.001 - -
42	Red(S)	Alexandria, La.	1	<0.001 - -	0.001 - -
35	Ohio	Cairo, Ill.	4	neg** - neg**	0.001 - 0.016

* Concentration values are calculated from quantitative gas chromatographic analysis of the material obtained by thin layer chromatographic separation of the aromatic fraction of the CCE. In the light of the unknown efficiency of carbon adsorption sampling for these compounds, the reported values represent minima; the actual values being equal to or most likely greater than the reported values.

** Negative.

Table III

Concentration of Endrin at Three Mississippi River Water Pollution Surveillance System Stations as Shown by the Carbon Adsorption Method in the Low-flow Month of Each of Six Consecutive Years.

ENDRIN
ppb*

Station No.	Location	1958	1959	1960	1961	1962	1963
23	Cape Girardeau, Mo.	0.013	neg**	neg**	neg**	neg**	<0.001
22	West Memphis, Ark.	0.004	0.002	0.007	neg**	0.006	0.214
20	New Orleans, La.	0.001	neg**	0.064	0.029	0.160	0.082

* Concentration values are calculated from quantitative gas chromatographic analysis of the material obtained by thin layer chromatographic separation of the aromatic fraction of the CCE. In the light of the unknown efficiency of carbon adsorption sampling for these compounds, the reported values represent minima; the actual values being equal to or most likely greater than the reported values.

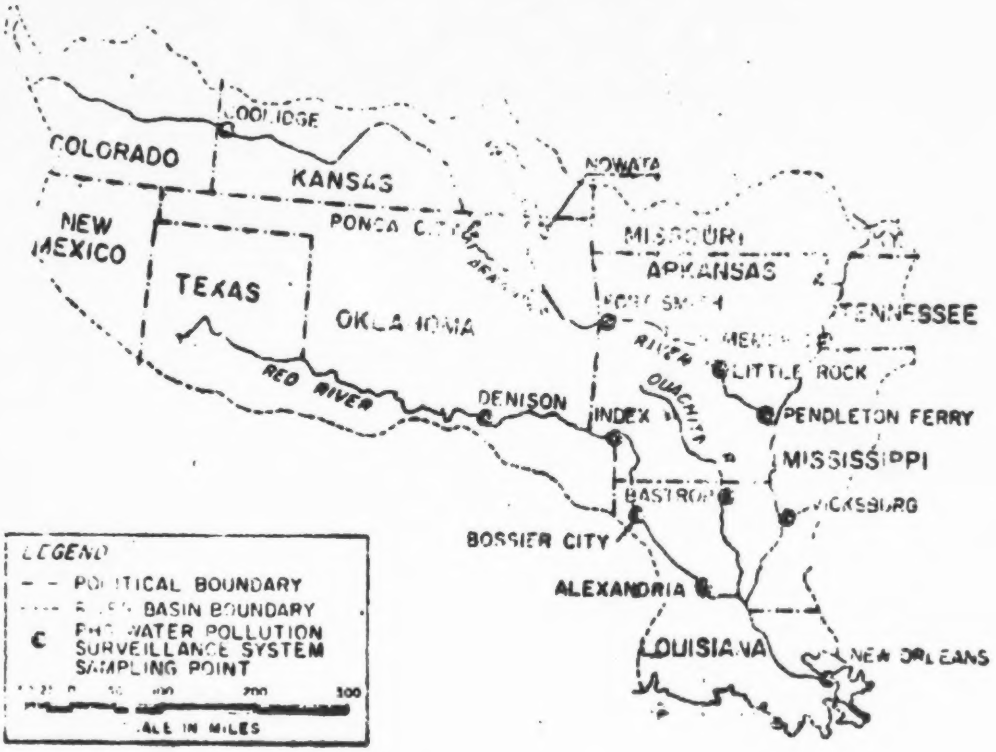
** Negative.

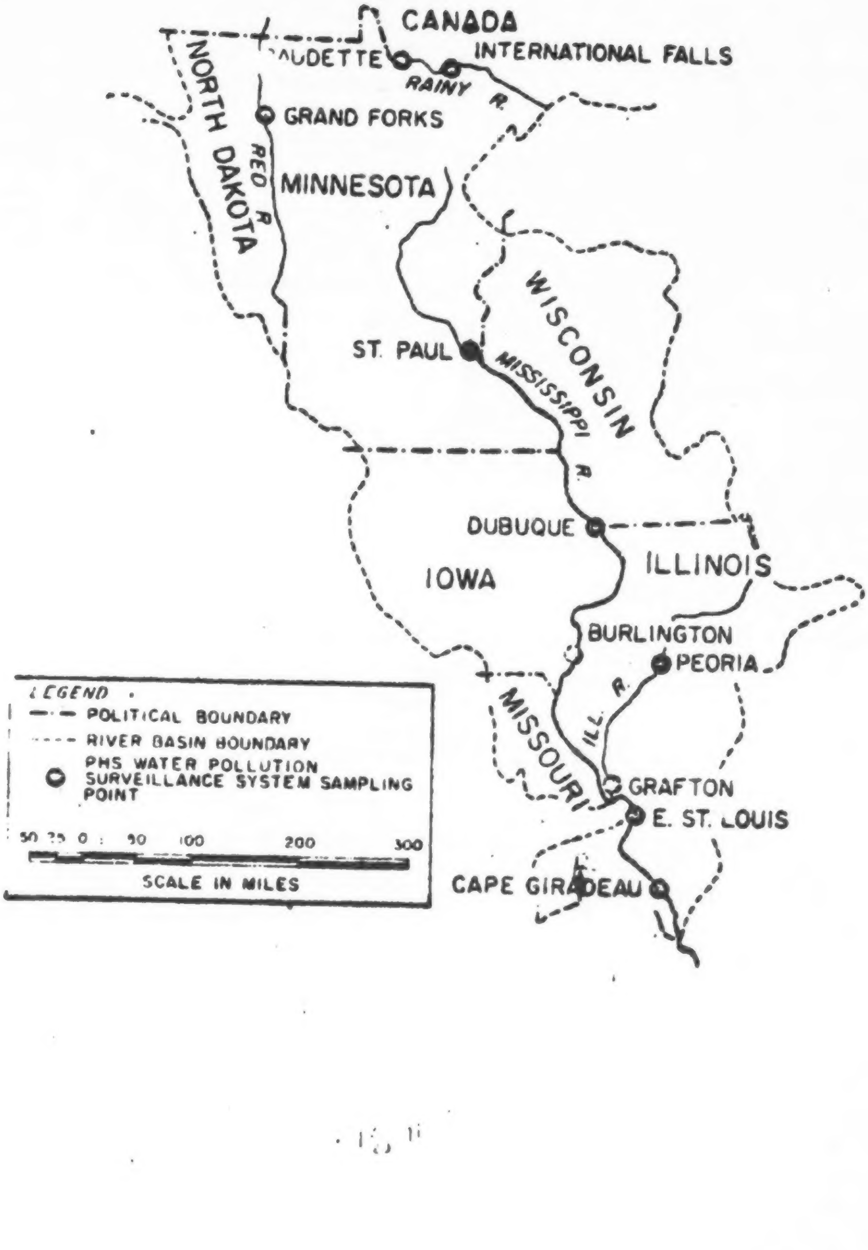
Table IV

Concentration of Endrin and Dieldrin in One-Liter Samples
Collected During the Period April 14-22, 1964.

River	Location	Date Sampled	Endrin ppb	Dieldrin ppb
Nonconnah Creek	Drainage Canal below dump at U.S. Highway #55 Bridge Memphis, Tennessee	4/14/64	0.664	0.240
Yazoo	Redwood, Miss.	4/15/64	-	-
Arkansas	WPSS #131, Little Rock	4/14/64	-	-
Big Black	@ Warren-Hinds Co.-Line Bridge on Mississippi 27	4/15/64	-	0.035
Red	Alexandria, La.	4/21/64	-	-
Black	Jonesville, La.	4/21/64	-	-
Old	Diversion Outfall Canal, La.	4/21/64	-	-
Atchafalaya	Morgan City, La.	4/22/64	-	-
Atchafalaya	Krotz Springs, La.	4/22/64	-	-
Mississippi	St. Francisville, La.	4/21/64	-	-

BASIN MAPS SHOWING LOCATION OF
WATER POLLUTION SURVEILLANCE SYSTEM
STATIONS


COLORADO
COOLIDGE
KANSAS
NOWATA
NEW MEXICO
PONCA CITY
TEXAS
OKLAHOMA
MISSOURI
KY.
ARKANSAS
FORT SMITH
TENNESSEE
MEMPHIS
RIVER
LITTLE ROCK
OUACHITA
PENDLETON FERRY
RED RIVER
DENISON
INDEX
MISSISSIPPI
BASTROP
VICKSBURG
BOSSIER CITY
ALEXANDRIA
LOUISIANA
NEW ORLEANS
LEGEND
POLITICAL BOUNDARY
RIVER BASIN BOUNDARY
PHS WATER POLLUTION SURVEILLANCE SYSTEM SAMPLING POINT
50 0 50 100 200 300
SCALE IN MILES


CANADA
BAUDETTE
INTERNATIONAL FALLS
RAINY R.
GRAND FORKS
NORTH DAKOTA
RED R.
MINNESOTA
WISCONSIN
ST. PAUL
MISSISSIPPI R.
DUBUQUE
IOWA
ILLINOIS
BURLINGTON
PEORIA
ILL. R.
MISSOURI
GRAFTON
E. ST. LOUIS
CAPE GIRARDEAU
LEGEND
POLITICAL BOUNDARY
RIVER BASIN BOUNDARY
PHS WATER POLLUTION SURVEILLANCE SYSTEM SAMPLING POINT
50 25 0 50 100 200 300
SCALE IN MILES

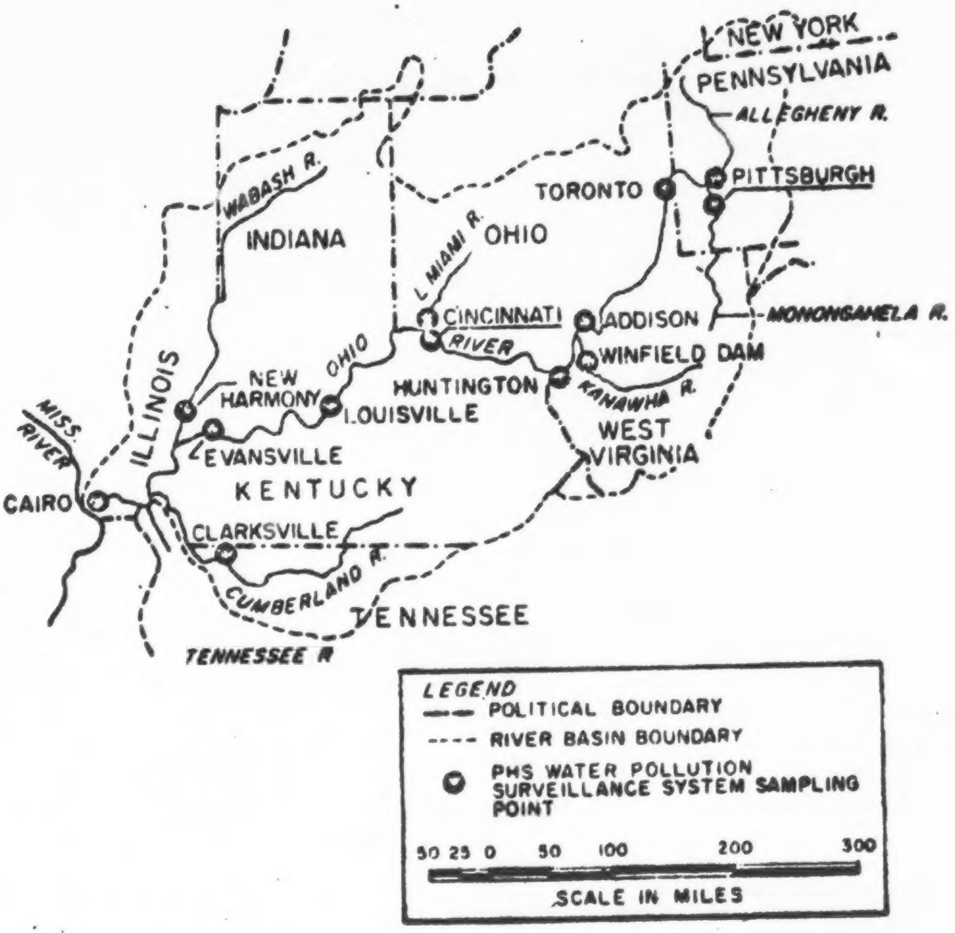
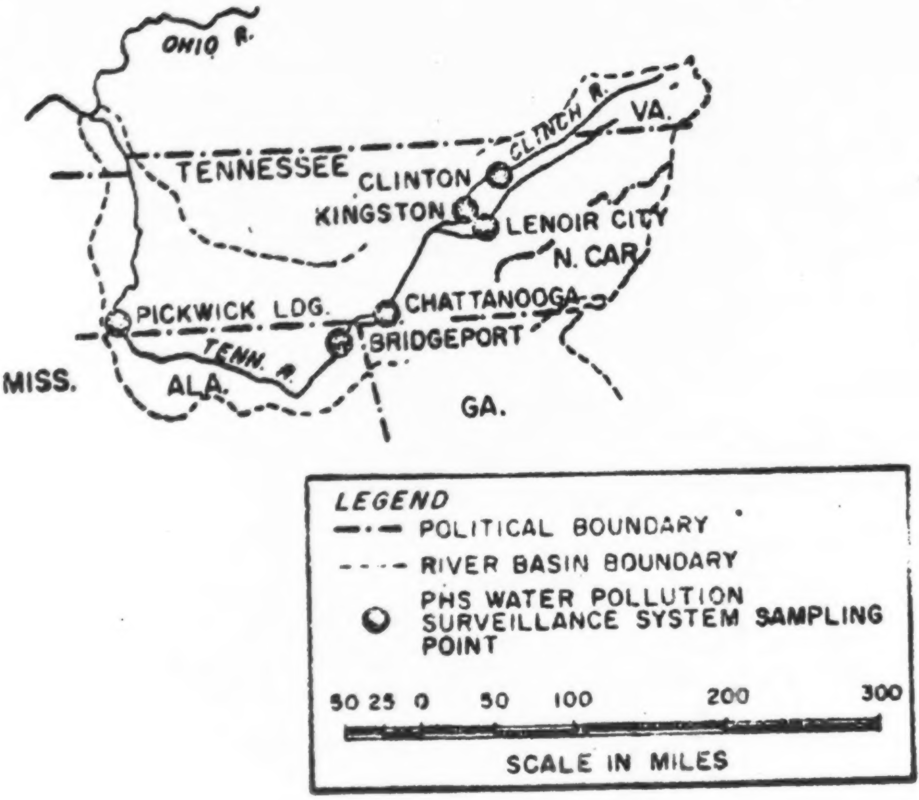

NEW YORK
PENNSYLVANIA
ALLEGHENY R.
PITTSBURGH
TORONTO
WABASH R.
INDIANA
L MIAMI R.
OHIO
CINCINNATI
RIVER
ADDISON
MONONGAHELA R.
WINFIELD DAM
HUNTINGTON
KANAWHA R.
NEW
HARMONY
OHIO
LOUISVILLE
ILLINOIS
MISS.
RIVER
EVANSVILLE
WEST
VIRGINIA
KENTUCKY
CAIRO
CLARKSVILLE
CUMBERLAND R.
TENNESSEE
TENNESSEE R
LEGEND
POLITICAL BOUNDARY
RIVER BASIN BOUNDARY
PHS WATER POLLUTION SURVEILLANCE SYSTEM SAMPLING POINT
50 25 0 50 100 200 300
SCALE IN MILES

FIG. [illegible]


OHIO R.
TENNESSEE
CLINCH R.
VA.
CLINTON
KINGSTON
LENOIR CITY
N. CAR.
PICKWICK LDG.
CHATTANOOGA
BRIDGEPORT
TENN. R.
MISS.
ALA.
GA.
LEGEND
POLITICAL BOUNDARY
RIVER BASIN BOUNDARY
PHS WATER POLLUTION SURVEILLANCE SYSTEM SAMPLING POINT
50 25 0 50 100 200 300
SCALE IN MILES

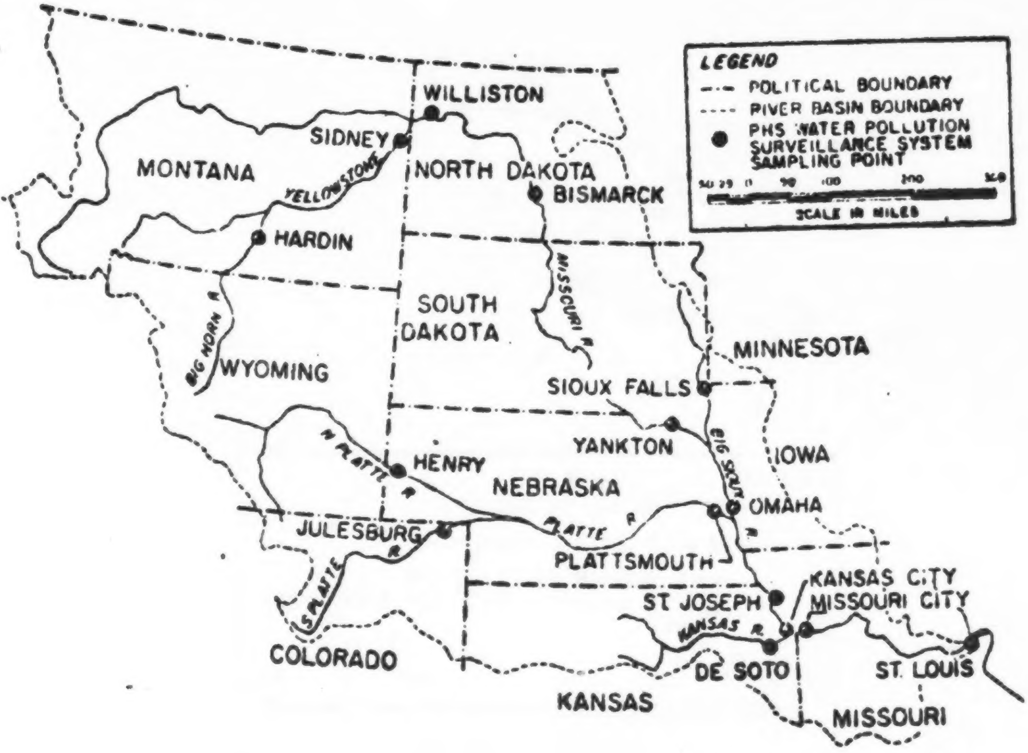

LEGEND
POLITICAL BOUNDARY
RIVER BASIN BOUNDARY
PHS WATER POLLUTION SURVEILLANCE SYSTEM SAMPLING POINT
50 25 0 50 100 200 300
SCALE IN MILES
WILLISTON
SIDNEY
MONTANA
YELLOWSTONE
NORTH DAKOTA
BISMARCK
HARDIN
MISSOURI R.
SOUTH DAKOTA
BIG HORN R.
WYOMING
MINNESOTA
SIOUX FALLS
YANKTON
IOWA
BIG SIOUX
N. PLATTE R.
HENRY
NEBRASKA
OMAHA
JULESBURG
PLATTE R.
PLATTSMOUTH
S. PLATTE R.
KANSAS CITY
ST JOSEPH
MISSOURI CITY
KANSAS R.
COLORADO
DE SOTO
ST. LOUIS
KANSAS
MISSOURI

Fig. VI

WATER POLLUTION SURVEILLANCE SYSTEM

STATION INFORMATION SHEETS

SUMMARY

State : Louisiana

Major Basin : Southwest-Lower Mississippi River

Minor Basin : Lower Mississippi-Natches to Gulf

Station Location : Mississippi River at New Orleans, Louisiana

Station at : 29°57'40" Latitude 90°07'50" Longitude

Miles above mouth: 105

Description of Facility : Samples taken at water plant intake.

Activation Date : December 12, 1957

Sampled by : New Orleans Sewage and Water Board

Field Analysis by: Louisiana State Department of Health

Other Cooperating Agencies: None

Hydrologic Data:

Nearest pertinent gaging station: at Red River Landing, La.

Gaging station operated by: U.S. Army Corps of Engineers

Drainage area at gaging station: 1,243,000 square miles

Period of record: 1935 to 1961

Average discharge in record period: 468,000 cfs.

Maximum discharge in record period: —

Minimum discharge in record period: —

Remarks: Flow of Mississippi River at this point influenced by many upstream lakes, dams and reservoirs on tributaries and mainstem.

SUMMARY

tate	:	Mississippi
ajor Basin	:	Southwest-Lower Mississippi River
inor Basin	:	Lower Mississippi-Yazoo Rivers
tation Location	:	Mississippi River at Vicksburg, Mississippi
tation at	:	32°19' Latitude 90°54' Longitude
les above mouth	:	431
scription of Facility	:	Samples collected at municipal water plant intake.
tivation Date	:	1957-1959; reactivated May 1961
mpled by	:	Vicksburg Water Department
eld Analysis by	:	Vicksburg Water Department

ther Cooperating Agencies: Mississippi State Board of Health

Louisiana State Department of Health

drologic Data:

Nearest pertinent gaging station: near Vicksburg, Miss.

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 1,144,500 square miles

Period of record: 1928 to present

Average discharge in record period: 564,000 cfs.

Maximum discharge in record period: 2,080,000 cfs.

Minimum discharge in record period: 99,400 cfs.

marks: Flow affected by navigation dams and reservoirs. Sampling point on East Bank of river below confluence of Yazoo and Mississippi Rivers. Sample may be significantly influenced by Yazoo River flow, particularly during periods of low flow in the Mississippi

SUMMARY

State	Louisiana
Major Basin :	Southwest-Lower Mississippi River
Minor Basin :	Lower Mississippi-Yazoo Rivers
Station Location :	Mississippi River at Delta, Louisiana
Station at :	32°20' Latitude 90°55' Longitude
Miles above mouth	432
Description of Facility :	Samples collected from pier at river landing, Delta Casting Yard, U.S. Army Corps of Engineers.
Activation Date :	October 6, 1958
Sampled by :	Mississippi State Board of Health
Field Analysis by.	Mississippi State Board of Health

Other Cooperating Agencies: Louisiana State Department of Health

Hydrologic Data:

Nearest pertinent gaging station: near Vicksburg, Mississippi

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 1,144,500 square miles

Period of record: 1928 to present

Average discharge in record period: 563,600 cfs.

Maximum discharge in record period: 2,080,000 cfs.

Minimum discharge in record period: 99,400 cfs.

Remarks: Flow affected by navigation dams and reservoirs.

SUMMARY

State : Arkansas

Major Basin : Southwest-Lower Mississippi River

Minor Basin : Lower Mississippi-Cairo to Helena

Station Location : Mississippi River at West Memphis, Arkansas

Station at : 35°07' Latitude 90°10' Longitude

Miles above mouth: 725

Description of Facility : Samples collected from dock of Oklahoma-Mississippi River Products Company.

Activation Date : January 1958

Sampled by : Memphis (Tennessee) Light, Gas and Water Division

Field Analysis by: Memphis (Tennessee) Light, Gas and Water Division

Other Cooperating Agencies: Arkansas State Board of Health
Tennessee Department of Public Health

Hydrologic Data:

Nearest pertinent gaging station: at Memphis, Tenn.

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 932,800 square miles

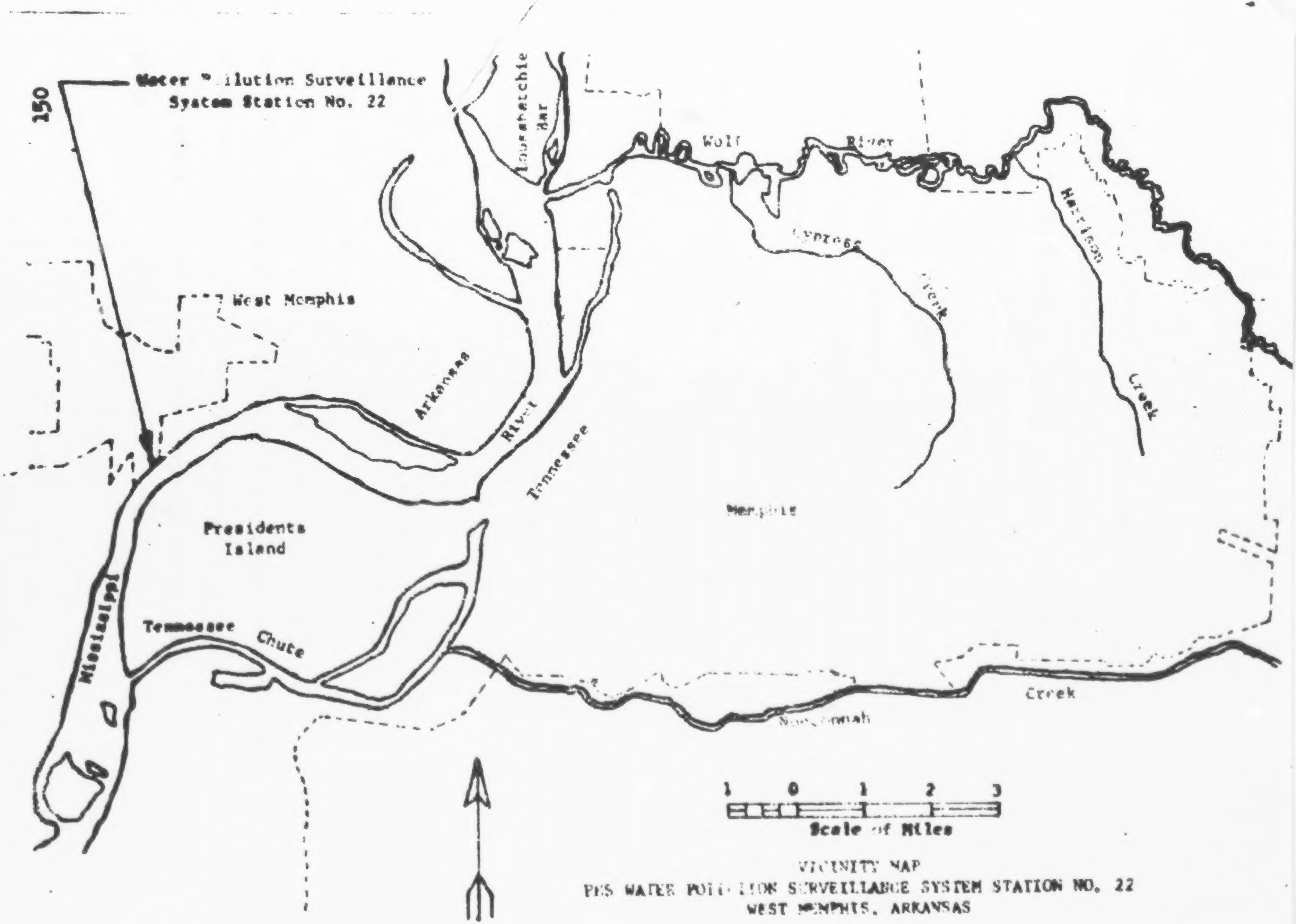
Period of record: 1933 to present

Average discharge in record period: 460,800 cfs.

Maximum discharge in record period: 1,980,000 cfs.

Minimum discharge in record period: 79,200 cfs.

Remarks: Flow affected by navigation dams and reservoirs.


150
Water Pollution Surveillance
System Station No. 22
Loosahatchie
Bar
Wolf
River
West Memphis
Cypress
Creek
Harrison
Creek
Arkansas
River
Tennessee
Memphis
Presidents
Island
Mississippi
Tennessee
Chute
Nonconnah
Creek
1 0 1 2 3
Scale of Miles

VICINITY MAP
PHS WATER POLLUTION SURVEILLANCE SYSTEM STATION NO. 22
WEST MEMPHIS, ARKANSAS

SUMMARY

State : Missouri

Major Basin : Upper Mississippi River

Minor Basin : Mississippi-Cape Girardeau Area

Station Location : Mississippi River at Cape Girardeau, Missouri

Station at : 37°18'50" Latitude 89°30'50" Longitude

Miles above mouth: 1020

Description of Facility : Samples collected at municipal water plant intake.

Activation Date : January 6, 1958

Sampled by : Missouri Utilities Company

Field Analysis by: Missouri Utilities Company

Other Cooperating Agencies: Missouri Department of Public Health
Missouri Water Pollution Board

Hydrologic Data:

Nearest pertinent gaging station: at Thebes, Illinois

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 717,200 square miles

Period of record: 1932 to present

Average discharge in record period: 180,600 cfs.

Maximum discharge in record period: 893,000 cfs.

Minimum discharge in record period: 23,400 cfs.

Remarks: Flow affected by reservoirs and irrigation diversions.

[illegible]

State : Illinois

Major Basin : Upper Mississippi River

Minor Basin : Mississippi River - St. Louis area

Station Location : Mississippi River at East St. Louis, Illinois.

Station at : 38°39' Latitude 90°11' Longitude

Miles above mouth: 1166

Description of Facility : Samples collected at municipal water plant intake.

Activation Date : December 24, 1957

Sampled by : East St. Louis Water Company

Field Analysis by: East St. Louis Water Company

Other Cooperating Agencies: Illinois State Department of Public Health

Hydrologic Data:

Nearest pertinent gaging station: at Alton, Illinois

Gaging station operated by: U. S. Geological Survey

Drainage area at gaging station: 171,500 square miles

Period of record: 1927 to present

Average discharge in record period: 93,910 cfs.

Maximum discharge in record period: 437,000 cfs.

Minimum discharge in record period: 7,960 cfs.

Remarks: Flow affected by reservoirs and navigation.

SUMMARY

State : Iowa

Major Basin : Upper Mississippi River

Minor Basin : Mississippi-Des Moines-Skunk Rivers

Station Location : Mississippi River at Burlington, Iowa

Station at : 40°47'45" Latitude 91°03'40" Longitude

Miles above mouth: 1369

Description of Facility : Samples collected at municipal water plant intake.

Activation Date : October 28, 1957

Sampled by : Burlington Water Department

Field Analysis by: Burlington Water Department

Other Cooperating Agencies: Iowa State Department of Health

Hydrologic Data:

Nearest pertinent gaging station: at Keokuk, Iowa

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 119,000 square miles

Period of record: 1878 to present

Average discharge in record period: 60,980 cfs.

Maximum discharge in record period: 314,000 cfs.

Minimum discharge in record period: 5,000 cfs.

Remarks: Flow regulated by power plants, reservoirs and navigation.

[illegible] SUMMARY

State : Iowa

Major Basin : Upper Mississippi River

Minor Basin : Mississippi-Wapsipinicon and Trib.

Station Location : Mississippi River at Dubuque, Iowa

Station at : 42° 31' Latitude 90° 39' Longitude

Miles above mouth: 1549

Description of Facility : Samples collected at U. S. Army Corps of Engineers Lock and Dam No. 11

Activation Date : December 2, 1957

Sampled by : Dubuque Water Department

Field Analysis by: Dubuque Water Department

Other Cooperating Agencies: Iowa State Department of Health

Hydrologic Data:

Nearest pertinent gaging station: At McGregbr, Iowa

Gaging station operated by: U. S. Geological Survey

Drainage area at gaging station: 67,500 square miles

Period of record: 1936 to present

Average discharge in record period: 31,780 cfs

Maximum discharge in record period: 197,500 cfs

Minimum discharge in record period: 6,200 cfs

Remarks: Flow regulated by navigation dams and reservoirs.

SUMMARY

State Minnesota

Major Basin : Upper Mississippi River

Minor Basin : Upper Portion - Upper Mississippi

Station Location : Mississippi River Lock and Dam #3 Below
St. Paul, Minnesota

Station at : 44° 34' Latitude 92° 34' Longitude

Miles above mouth: 1757

Description of Facility : Samples collected at U. S. Army Corps of Engineers Lock and Dam #3

Activation Date : October 30, 1957

Sampled by : U. S. Army Corps of Engineers
Minneapolis-St. Paul Sanitary District

Field Analysis by: Minneapolis-St. Paul Sanitary District

Other Cooperating Agencies: Minnesota State Board of Health

Hydrologic Data:

Nearest pertinent gaging station: at Prescott, Wisconsin

Gaging station operated by: U. S. Geological Survey

Drainage area at gaging station: 44,800 square miles

Period of record: 1928 to present

Average discharge in record period: 14,790 cfs

Maximum discharge in record period: 155,000 cfs

Minimum discharge in record period: 1380 cfs

Remarks: Low and medium flows affected by reservoirs, power plants, and navigation. High flows not influenced.

SUMMARY

State : Illinois

Major Basin : Ohio River

Minor Basin : Ohio River - Main Stem and Minor Tributary

Station Location : Ohio River at Cairo, Illinois

Station at : 37°06' Latitude 89°09' Longitude

Miles above mouth: 3

Description of Facility : Samples collected at municipal water plant intake.

Activation Date : April 7, 1958

Sampled by : Cairo Water Company

Field Analysis by: Cairo Water Company

Other Cooperating Agencies: Illinois State Department of Public Health

Hydrologic Data:

Nearest pertinent gaging station: at Metropolis, Illinois

Gaging station operated by: U. S. Geological Survey

Drainage area at gaging station: 203,000 square miles

Period of record: 1934 to present

Average discharge in record period: 260,100 cfs.

Maximum discharge in record period: 1,780,000 cfs.

Minimum discharge in record period: 20,600 cfs.

Remarks: Flow regulated by navigation locks and dams.

[illegible]

State : Missouri

Major Basin : Missouri River

Minor Basin : Lower Missouri below Niobrara River

Station Location : Missouri River at Missouri City, Missouri

Station at : 39°14'10" Latitude 97°17'50" Longitude

Miles above mouth: 344

Description of Facility : Samples collected at North West Electric Power Cooperative's plant intake.

Activation Date : January 29, 1962

Sampled by : North West Electric Power Cooperative Inc.

Field Analysis by: U.S. Public Health Service

Other Cooperating Agencies: Missouri Water Pollution Board
Missouri Department of Public Health

Hydrologic Data:

Nearest pertinent gaging station: Kansas City, Missouri

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 489,200 square miles

Period of record: 1897 to present

Average discharge in record period: 55,290 cfs.

Maximum discharge in record period: 573,000 cfs.

Minimum discharge in record period: about 1,500 cfs.

Remarks: Blue River confluent to Missouri between gaging station and pollution surveillance station. Flow partially regulated by reservoirs upstream and on tributaries.

SUMMARY

State : Tennessee

Major Basin : Tennessee River

Minor Basin : Tennessee River - Main Stem and Minor Tributary

Station Location : Tennessee River at Pickwick Landing, Tennessee

Station at : 35°04' Latitude 88°15' Longitude

Miles above mouth: 207

Description of Facility : Samples collected at Pickwick Landing Dam powerhouse.

Activation Date : October 24, 1961

Sampled by : Hardin County Tennessee Health Department

Field Analysis by: U.S. Public Health Service

Other Cooperating Agencies: Tennessee Stream Pollution Control Commission
Tennessee Department of Public Health

Hydrologic Data:

Nearest pertinent gaging station: at Savannah, Tennessee

Gaging station operated by: Tennessee Valley Authority

Drainage area at gaging station: 33,140 square miles

Period of record: 1930 to present

Average discharge in record period: [illegible],000 cfs.

Maximum discharge in record period: 40[illegible],000 cfs.

Minimum discharge in record period: 1,100 cfs.

Remarks: Minimum discharge atypical. Resulted from experimental closure of Pickwick Landing Dam. Flow regulated by upstream reservoirs.

SUMMARY

State : Kansas

Major Basin : Missouri River

Minor Basin : Lower Missouri below Niobrara River

Station Location : Missouri River at Kansas City, Kansas

Station at : 39°10' Latitude 94°37' Longitude

Miles above mouth: 374

Description of Facility : Samples collected at municipal water plant intake.

Activation Date : November 4, 1957

Sampled by : Kansas City (Kansas) Board of Public Utilities

Field Analysis by: Kansas City (Kansas) Board of Public Utilities

Other Cooperating Agencies: Kansas State Board of Health

Hydrologic Data:

Nearest pertinent gaging station: See Remarks

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: Estimated 429,000 square miles at surveillance station

Period of record: —

Average discharge in record period; Estimated 48,500 cfs. at surveillance station

Maximum discharge in record period: —

Minimum discharge in record period: —

Remarks: Flow at Kansas City computed as Missouri River at Kansas City, Missouri plus Kansas River at Bonner Springs, Kansas.

SUMMARY

State : Missouri

Major Basin : Missouri River

Minor Basin : Lower Missouri below Niobrara River

Station Location : Missouri River at St. Louis, Missouri

Station at : 41°41' Latitude 90°34' Longitude

Miles above mouth: 36

Description of Facility : Samples collected at intakes of St. Louis County Water Company and City of St. Louis' Howard Bend Plant.

Activation Date : October 1957

Sampled by :
St. Louis County Water Company
St. Louis Water Department

Field Analysis by:
St. Louis County Water Company
St. Louis Water Department

Other Cooperating Agencies: Missouri Department of Public Health
Missouri Water Pollution Board

Hydrologic Data:

Nearest pertinent gaging station: at Hermann, Missouri

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 528,200 square miles

Period of record. 1897 to present

Average discharge in record period: 79,570 cfs.

Maximum discharge in record period: 676,000 cfs.

Minimum discharge in record period: 4,200 cfs.

Remarks:

State Arkansas

Major Basin : Southwest-Lower Mississippi River

Minor Basin : Arkansas River-Van Buren to Mouth

Station Location : Arkansas River at Little Rock, Arkansas

Station at : $34^{\circ}45'$ Latitude $92^{\circ}16'$ Longitude

Miles above mouth: 167 estimated

Description of Facility : Samples are collected at pipe yard of Little Rock Water Department.

Activation Date : July, 1963

Sampled by : Arkansas Water Pollution Control Commission

Field Analysis by: Arkansas Water Pollution Control Commission

Other Cooperating Agencies: Arkansas State Board of Health

Hydrologic Data:

Nearest pertinent gaging station: at Little Rock, Arkansas

Gaging station operated by: U.S. Geological Survey

Drainage area at gaging station: 158,200 square miles with 22,241 square miles probably non-contributing.

Period of record: 1957 to present

Average discharge in record period: 42,250 cfs.

Maximum discharge in record period: 536,000 cfs.

Minimum discharge in record period: 850 cfs.

Remarks: Some regulation by power plants and upstream storage reservoirs.

SUMMARY

State : **Louisiana**

Major Basin : Southwest-Lower Mississippi River

Minor Basin : **Lower Red River Below Denison**

Station Location : Red River At
Alexandria, Louisiana

Station at : 31° 18' 36" Latitude. 92° 25' 42" Longitude

Miles above mouth: 121

Description of Facility : Samples collected from Alexandria-Pineville Expressway Bridge, U. S. Highway 165.

Activation Date : November 18, 1957

Sampled by : Alexandria Water Department

Field Analysis by: Louisiana State Department of Health, Alexandria Laborat

Other Cooperating Agencies: Louisiana State Department of Health

Hydrologic Data:

Nearest pertinent gaging station: At Alexandria, Louisiana

Gaging station operated by: U. S. Army, Corps of Engineers

Drainage area at gaging station: 67,500 square miles

Period of record: 1928 to present

Average discharge in record period: 32,530 cfs.

Maximum discharge in record period: 233,000 cfs.

Minimum discharge in record period: 873 cfs.

Remarks:

CHARTS

CHART I

LOCATION OF SAMPLING STATIONS

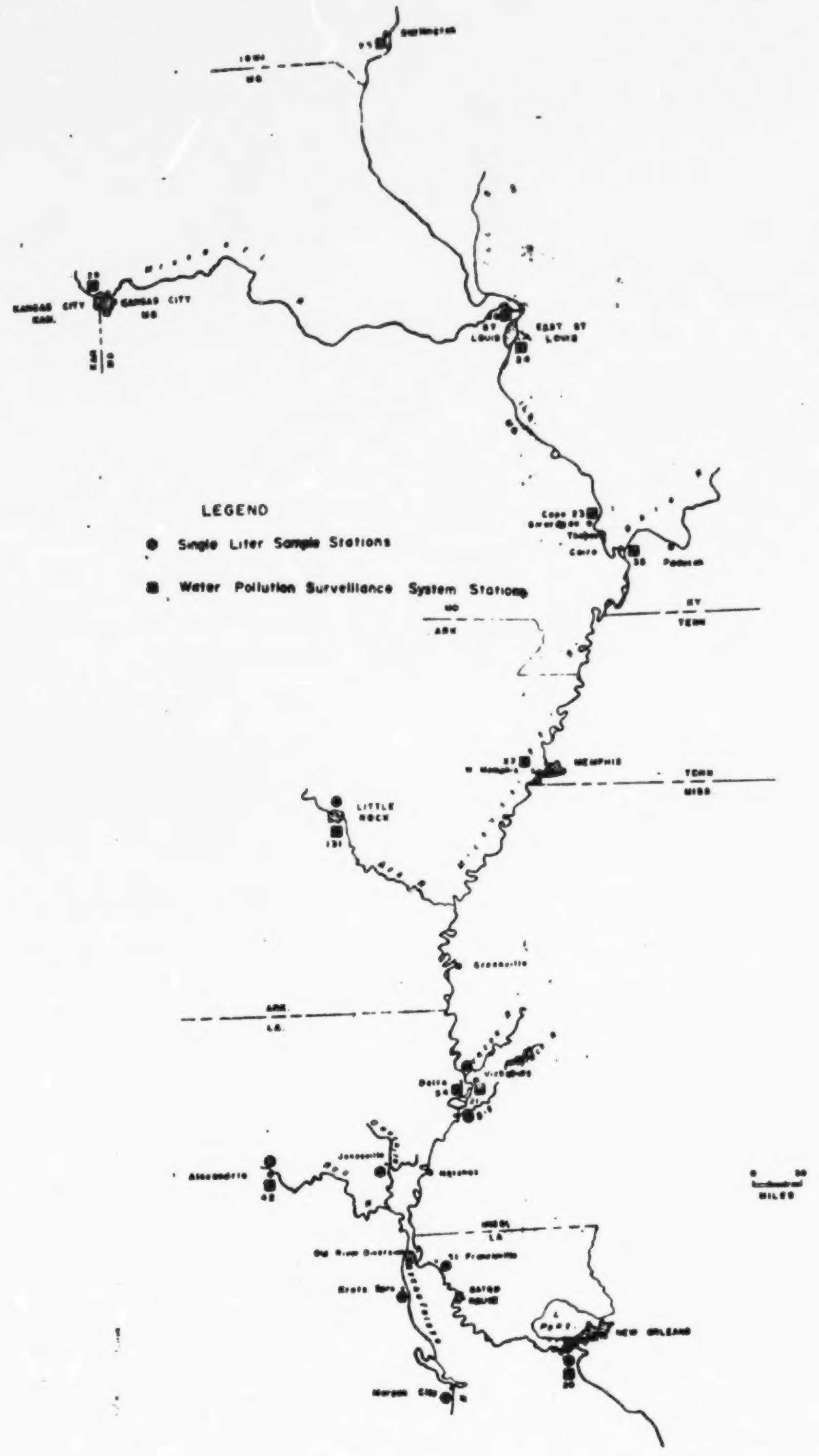

IOWA
MO
KANSAS CITY KAN.
KANSAS CITY MO
ST LOUIS
EAST ST LOUIS
LEGEND
● Single Liter Sample Stations
■ Water Pollution Surveillance System Stations
Cape
Cairo
Paducah
MO
ARK
KY
TENN
W Memphis
MEMPHIS
TENN
MISS
LITTLE ROCK
131
Greenville
ARK
LA
Vicksburg
Delta
Alexandria
Natchez
MISS
LA
St Francisville
BATON ROUGE
NEW ORLEANS
Morgan City
0 50
MILES

CHART 2

CARBON ADSORPTION METHOD DETERMINATIONS OF ENDRIN

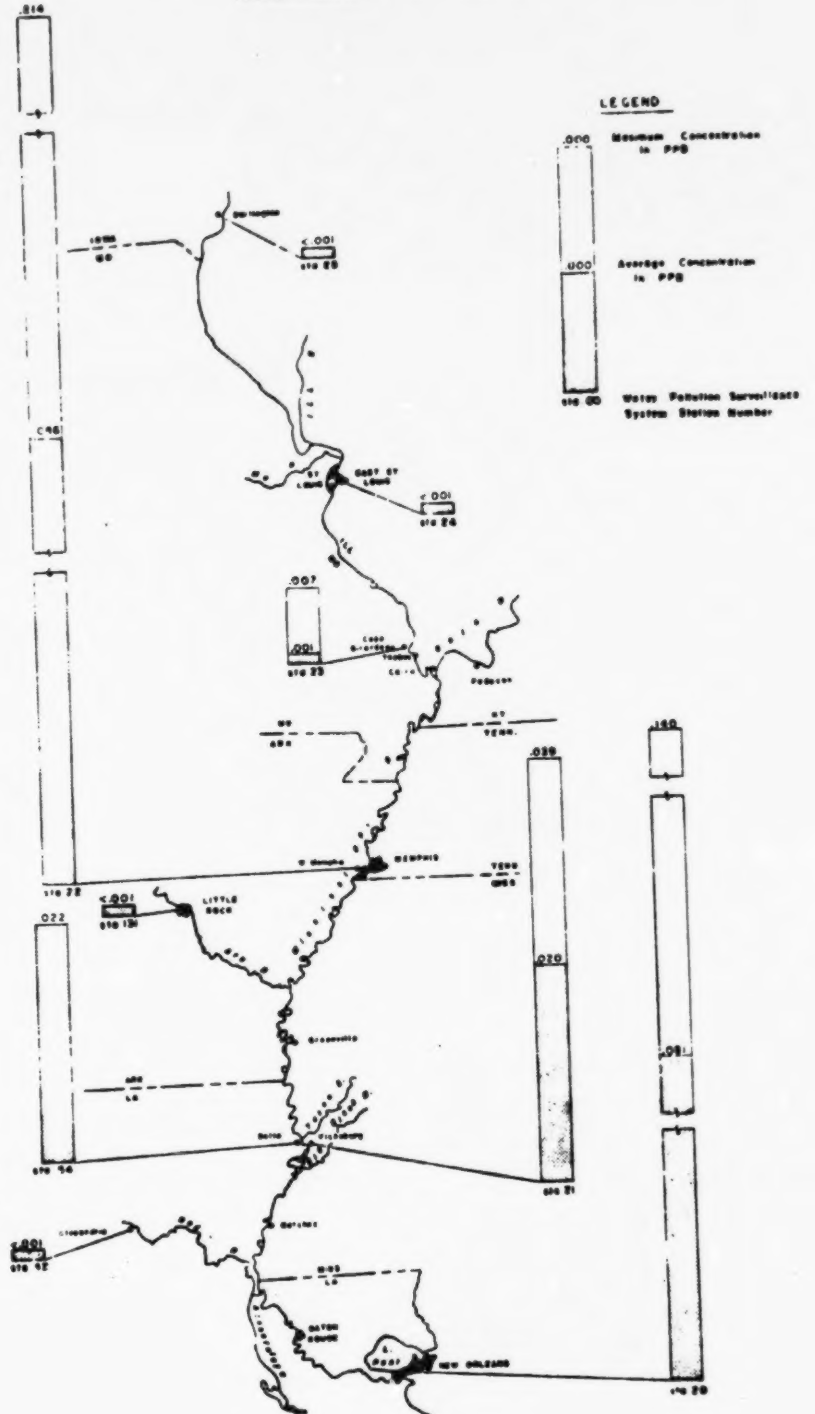

LEGEND
.000 Maximum Concentration in PPB
.000 Average Concentration in PPB
sta 00 Water Pollution Surveillance System Station Number
.814
<.001
sta 25
IOWA
MO
ST LOUIS
EAST ST LOUIS
<.001
sta 24
ILL
.007
.001
sta 23
Cape Girardeau
Thebes
Cairo
Paducah
KY
TENN
MO
ARK
W Memphis
MEMPHIS
TENN
MISS
sta 22
<.001
sta 131
LITTLE ROCK
.022
.039
.020
sta 21
.140
.081
Greenville
ARK
LA
Delta
Vicksburg
sta 96
Natchez
<.001
sta 42
MISS
LA
BATON ROUGE
NEW ORLEANS
sta 20

CHART 3

CARBON ADSORPTION METHOD DETERMINATIONS OF DIELDRIN

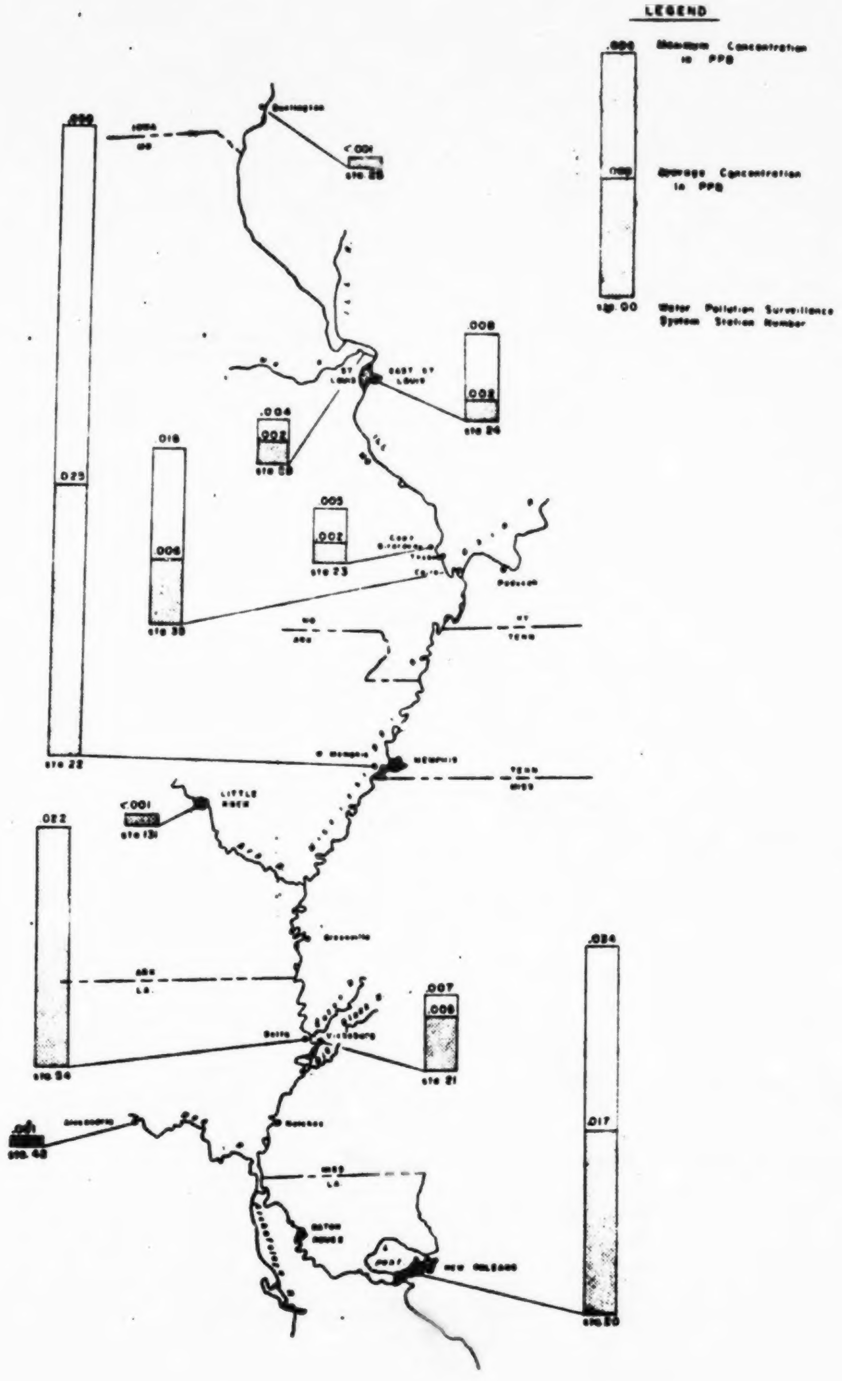

LEGEND
.000 Maximum Concentration in PPB
.000 Average Concentration in PPB
sta. 00 Water Pollution Surveillance System Station Number
Burlington
IOWA
MO
<.001
sta 26
ST LOUIS
EAST ST LOUIS
.008
.002
sta 24
.004
.002
sta 58
.025
sta 22
.016
.006
sta 30
.005
.002
sta 23
Cape Girardeau
Thebes
Cairo
Paducah
MO
ARK
KY
TENN
W Memphis
MEMPHIS
TENN
MISS
LITTLE ROCK
<.001
sta 131
.022
sta 54
Greenville
ARK
LA
Delta
Vicksburg
.007
.006
sta 21
Alexandria
.001
sta. 48
Natchez
MISS
LA
BATON ROUGE
NEW ORLEANS
.024
.017
sta 20

CHART 4

DETERMINATION OF ENDRIN & DIELDRIN IN GRAB SAMPLES

APRIL 14-22, 1964

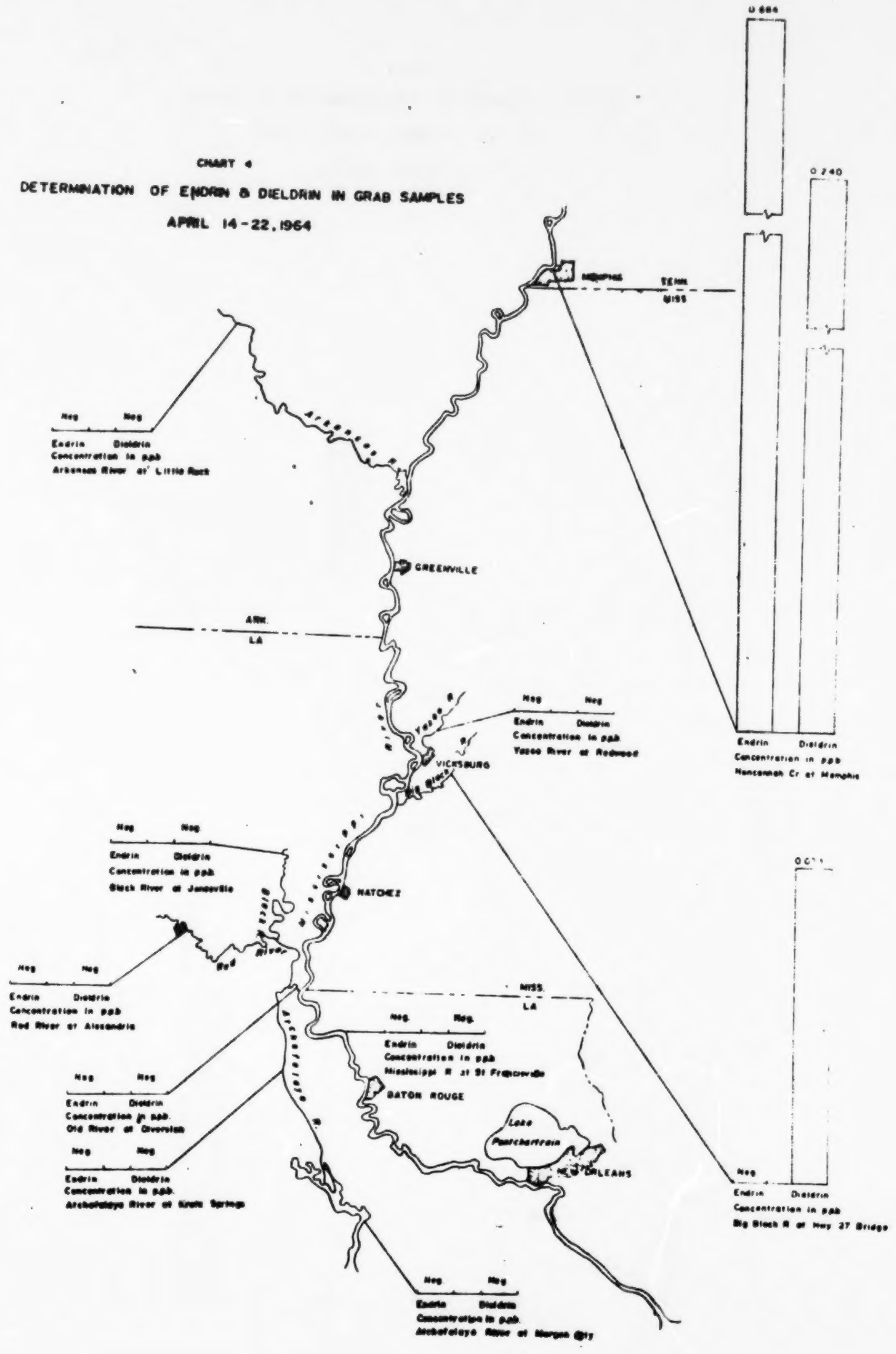
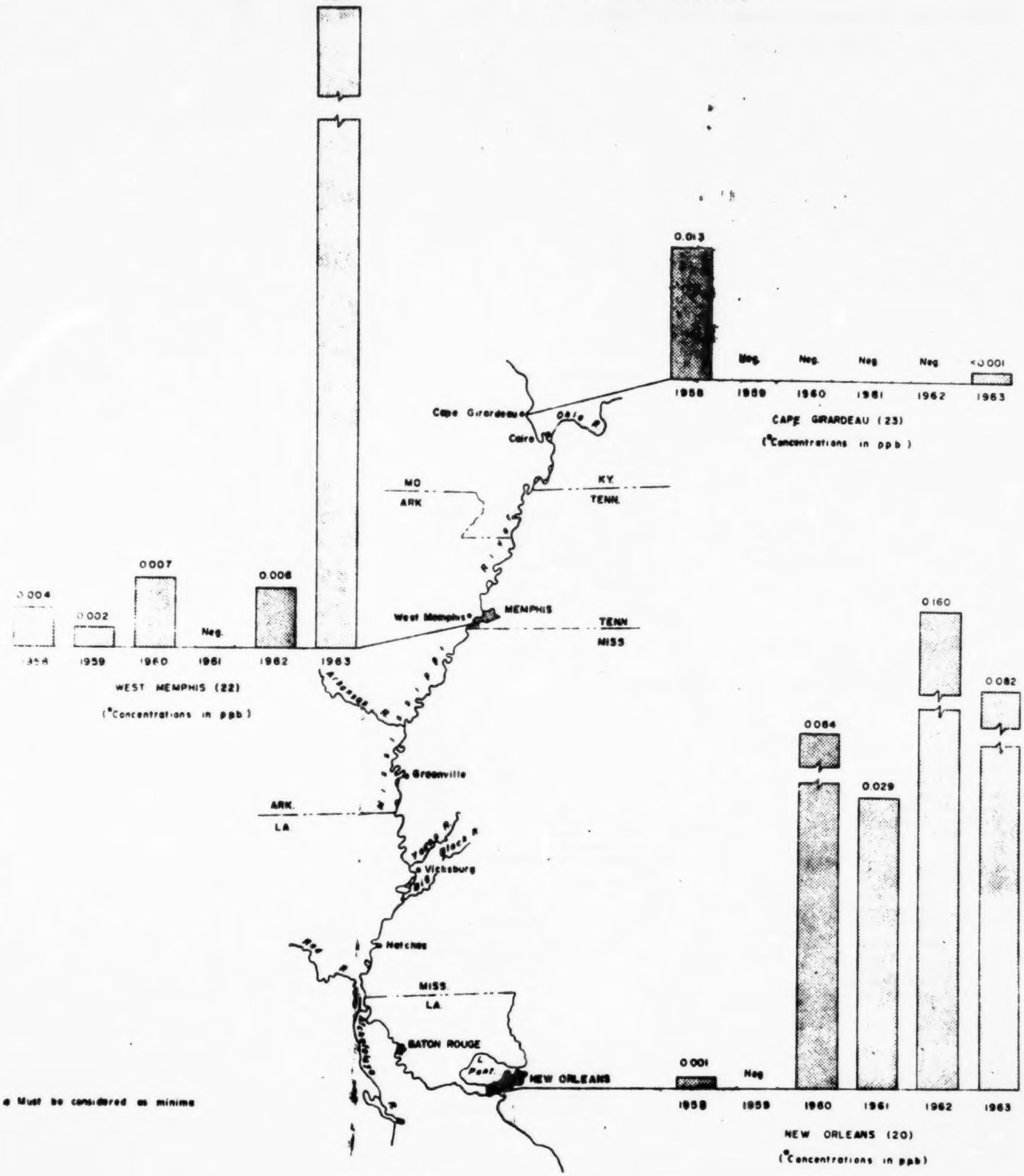

0 884
0 240
MEMPHIS
TENN
MISS
Endrin
Dieldrin
Concentration in ppb
Nonconnah Cr at Memphis
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Arkansas River at Little Rock
Arkansas R.
GREENVILLE
ARK.
LA
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Yazoo River at Redwood
Yazoo R.
VICKSBURG
Big Black R.
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Black River at Jonesville
Black R.
Mississippi R.
NATCHEZ
Red River
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Red River at Alexandria
MISS.
LA
Neg.
Neg.
Endrin
Dieldrin
Concentration in ppb
Mississippi R. at St Francisville
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Old River at Diversion
Atchafalaya R.
BATON ROUGE
Lake Pontchartrain
NEW ORLEANS
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Atchafalaya River at Krotz Springs
0 0
Neg
Endrin
Dieldrin
Concentration in ppb
Big Black R at Hwy 27 Bridge
Neg
Neg
Endrin
Dieldrin
Concentration in ppb
Atchafalaya River at Morgan City

CHART 8

CARBON ADSORBTION DETERMINATION OF ENDRIN IN THE PERIOD 1958 TO 1963

(LOW FLOW MONTHS)



* Must be considered as minima

MR. STEIN: Thank you, Dr. Breidenbach.

Are there any comments or questions?

MR. JONES: Murray, this doesn't agree with the data that was sent to us, these April samples. I know they were grab samples, but you did not show all the grab samples. For instance, you have Nonconnah Creek sample, April 26th, .14 Endrin and 0 Dieldrin.

DR. BREIDENBACH: Sir, other analyses from this area were done in another Public Health Service laboratory.

MR. JONES: Don't they cooperate?

DR. BREIDENBACH: Oh, yes, we cooperate, sir, but they are a part of a different section of this report.

MR. JONES: Who is going to report on that part?

DR. BREIDENBACH: I believe that would be Dr. Grzenda. Is that right, Mr. Chairman?

MR. STEIN: Yes.

MR. JONES: Good Lord, I can't keep it straight, but this was the only stuff that was sent to us. For instance, it shows here, and I am trying to find the source of this Endrin too.

MR. STEIN: So are we.

MR. JONES: But we are beating around the bush.

MR. STEIN: Oh, no.

MR. JONES: Here it shows 0 Endrin at the Memphis-

Arkansas Bridge. Now, why is this selected to show the Endrin in the Nonconnah Creek, and why weren't samples taken farther up Nonconnah to try to find the source?

DR. BREIDENBACH: There are further samples which will be reported on, sir.

This sample was sent to us. We analyzed it and we reported it.

MR. JONES: Good Lord, we aren't ready for a conference.

MR. STEIN: Don't say that, Leary. Now, just bear with this and watch it. What has happened here is --

MR. JONES: I'm getting hungry.

MR. STEIN: We will recess soon. We are just waiting for the completion of the questions.

As I understand this report, Dr. Mount, Dr. Schaefer, Dr. Breidenbach and Dr. Grzenda have done work in various aspects of this, using different samples and different techniques, slightly different techniques. They made all the information available to you.

MR. JONES: No, they didn't.

MR. STEIN: They did make it available.

MR. JONES: When?

MR. STEIN: As it became available.

MR. JONES: This says it was sent to us. It has not been sent.

MR. STEIN: It is, as it becomes available.

MR. JONES: I see.

MR. STEIN: As I understand it, if in applying at different sampling stations different techniques these people have come to the same conclusion, it seems to me that any appropriate question as to any specific technique of any one of our teams of investigators should await that man putting his material in. I think this will be the most orderly presentation.

The information that you are referring to, as I understand it, is contained in the next presentation of Dr. Grzenda, and he will be most happy to answer your question.

Again, as I understand this, Dr. Breidenbach has done a survey of the river. His information completely corroborates the other information.

We hope that this will develop, but, as I understand this situation, it works something like this: When there were some fish kills reported, Dr. Mount, who is an aquatic biologist, went down with his group, and Dr. Tarzwell's group to analyze the fish kills. They did certain analytical work, and they called on Dr. Schaefer to help them with the chemistry. This was done. They came up with the conclusion you have heard.

Dr. Breidenbach works with the network of stations. What is the name of that? It escapes me for the moment.

DR. BREIDENBACH: The Water Pollution Surveillance System.

MR. STEIN: The Water Pollution Surveillance System, which has, for many years, and will continue for many years, examined the waters of the Mississippi River and other rivers of the country for a variety of substances. These people, as I understand, have indicated they have found Endrin both coming in in significant portions above their station at West Memphis and significantly below it.

In addition to that, Dr. Grzenda, whom we have not heard from yet, conducted a special study on the Memphis area.

I suggest we leave his conclusions to Dr. Grzenda, but I would suggest again that if all these diverse investigators sent out come up with a similar or identical conclusion, then perhaps we are leading somewhere.

MR. JONES: Murray, my question is this: What we are doing is taking this in a spotty fashion. Who is going to coordinate this stuff where we can understand it?

MR. STEIN: Well, I think this will fall --

MR. JONES: Are you going to summarize it?

MR. STEIN: I certainly will.

MR. JONES: Good. That is what I am waiting for.

MR. STEIN: As a matter of fact, Leary, on the basis of our working together for years, I am sure you are going to be the first one to understand it.

MR. JONES: When, though?

MR. STEIN: When all the data comes in.

MR. JONES: Murray, what I am getting at is this now: We have been getting these things in piecemeal. We were handed this today to absorb. Now, somebody is going to need to put this thing together before we go home. Otherwise we will have to come back next month for another conference. I have seen this before, and you have too.

Now, we are getting this stuff so piecemeal that I have no intention of remembering all these figures and referring back 50 pages to try to tie this statement into that statement.

Has anyone summarized this?

MR. STEIN: Yes. You will have the summary.

MR. JONES: That is the next paper?

MR. STEIN: No. The next paper is that of another investigator.

This is why we need a conference. As the Supreme Court said long ago, you can't solve this by a court case or under oath. If there is any question as to facts or methodology, everyone is going to have an opportunity to see how this was arrived at, and we are going to lay the methodology and the investigations on the table.

I don't think it would be fair to people who may feel they have different views to have conclusions put out without a complete disclosure of what was done.

As I understand it, this material largely has been done by relatively new methods, and I think the material has been sent out as fast as it has come in. The point is that the material has not been kept for collation, and that is why it has come out the way it has.

With due deference to you, you know my limitations. I think I can understand this, and I am sure all the conferees and all the people in the room will understand it too.

MR. JONES: You flatter us. I hope you can summarize it, Murray.

MR. STEIN: Yes, Mr. Lafleur?

MR. LAFLEUR: Dr. Breidenbach, taking Table No. IV, for example, am I correct in assuming that where you have the little dash, this would be reported as zero, or would it be that you have not yet analyzed that sample?

VOICES FROM THE FLOOR: We can't hear.

MR. LAFLEUR: I am using as an example Table IV, and my question is whether or not I am correct in assuming that the little dash would indicate whether or not this sample has been analyzed, or you simply have analyzed it and reported it as zero?

DR. BREIDENBACH: The dash indicates a negative analysis. The substance at the head of the column was not found. A space in that position would indicate an analysis was not performed.

MR. LAFLEUR: Thank you.

MR. STEIN: Are there any further questions or comments?

MR. WOOD: Murray, I asked a question before which was referred to a later presentation. I don't know whether this is the time to ask it or not. That was with respect to peaks both on electron capture or on other methods of gas chromatography which were present, and were they identified, and, if so, what did you find? Were there peaks present which were not identified?

DR. BREIDENBACH: First of all, I assume you are talking about the carbon chloroform extracts first on the samples that we saw in the second chart, where Dieldrin and Endrin were identified?

MR. WOOD: Yes.

DR. BREIDENBACH: Yes, there are other substances there.

It is quite impossible at the present time to identify all of the substances that are there. The analytical tools that we have at the present time, however, make it possible for us to identify a substantial portion of the chlorinated hydrocarbon pesticides, and this we have done.

There are chlorinated hydrocarbon pesticides in smaller amounts than these samples which are reported in Tables I-1 to I-22, which support the statement I have just made.

In addition to that I would expect, although I have no proof, that there are other organic materials in the water, but the identification of the Endrin and the Dieldrin and other chlorinated hydrocarbon pesticides is determined. It is something about which a chemist could not be mistaken.

MR. WOOD: Dr. Schaefer made, reference to a positive identification of Endrin in the form of an infrared spectrum. This, I think we can both agree, is about as positive an identification as can be made.

DR. BREIDENBACH: That is right, sir.

MR. WOOD: Did your study take you into infrared identification or not?

DR. BREIDENBACH: Yes, sir. We used infrared as a part of the total system by which we identified these compounds, and the infrared spectra must support the identification before we report.

MR. WOOD: In this case, were you able to isolate the Endrin from the other organics, or did you get an algebraic summary spectrum of Endrin plus possible others?

DR. BREIDENBACH: In certain samples, we can see Endrin with interferences of, oh, less than 1 percent. In other samples, we can see Dieldrin in very clear form. In a third set of samples, we might see Endrin and Dieldrin mixed.

MR. WOOD: But what was your technique, if you don't mind a little bit, in isolating a sufficient amount of these two to get an I.R. spectrum?

MR. STEIN: Go right ahead.

DR. BREIDENBACH: Well, first of all, samples such as the ones that were obtained in maximum values at West Memphis and New Orleans, the spectra of the aromatic fraction itself without any further clean-up were sufficient to make an identification of Endrin.

MR. WOOD: There weren't appreciable quantities of other organics present then in this aromatic fraction of the carbon extract?

DR. BREIDENBACH: No, sir. The amount of Endrin was overriding. In one sample, even the odor was indicative.

MR. WOOD: We notice that on carbon filters, there is a considerable build-up of material which may be in suspension or it may be colloidal -- I am not sure. Is this stuff actually colloidal material and, if so, it adheres to your carbon granules. If so, is it extracted along with the carbon itself as a part of the total sample?

DR. BREIDENBACH: It would be correct to say that any silt, suspended matter, colloidal or otherwise, which is entrapped in the interstices between the carbon and is removed from the filter, dried and extracted, and if there were pesticides adsorbed on that material or other materials adsorbed on that material, that these would then be extracted as a chloroform soluble and become part of the chloroform extract.

MR. WOOD: Thank you.

MR. STEIN: Thank you.

Are there any further comments or questions?

(No response.)

MR. STEIN: Maybe this should be taken up later, but, as I understand Dr. Schaefer's technique -- and, Dr. Schaefer, correct me if I am wrong -- you largely did not use chloroform in your methods?

DR. SCHAEFER: No, sir.

MR. STEIN: You did not?

DR. SCHAEFER: We did not use chloroform at all.

MR. STEIN: That is right.

With this, I think we will recess for lunch.

MR. JONES: Before we adjourn, let's do some projecting on time.

I have a group who are going to have to leave early in the morning. How long is this going to run?

MR. STEIN: Well, I am sure it will run through tomorrow, and we will make adjustments in every way we can to handle your people from Tennessee. I will be glad to see you to make the arrangements, to get your people on as rapidly as we can.

MR. JONES: You have what -- two more papers, in here, in this book?

MR. STEIN: Yes.

MR. JONES: Dr. Grzenda's and Mr. Kittrell's. What is the estimated time there? In other words, it is 12:15 now. We can get a lot of shrimp in an hour. What are your plans this afternoon?

MR. STEIN: The plans are to go through this, and if you feel that you have to have someone here today --

MR. JONES: No, I don't feel that. I don't know yet.

Neither your statement nor the letter from the Secretary has explained the details that I have been after. Therefore, we have a number of people here --

MR. STEIN: It is expected that the people from the non-Federal agencies, unless we make a change -- and we are amenable to that, if you wish -- will probably make statements tomorrow. Today will probably be taken up with the Federal people.

MR. JONES: We will send in written statements on some of these.

MR. STEIN: All right. That is your privilege.

MR. JONES: But why don't we set up a schedule and let the States know what you are planning, or the Secretary, or whoever schedules this?

MR. STEIN: Leary, the schedule was set up. I am as far away as your telephone, and, as you well know, I accept collect calls.

MR. JONES: Do you want me to read your letter?

MR. STEIN: Yes, you can. Do you want to save that for after lunch?

MR. JONES: No. It is a short one. What it simply says is that the conference will be held on the basis of reports that have been sent to you, plus any other reports that might be sent. This was handed to me this morning.

MR. STEIN: Do you have a copy of that letter, sir?

MR. JONES: Yes, sir.

MR. STEIN: Does the last paragraph say that I would be in town yesterday, available for discussion? I was here and I didn't hear from you.

MR. JONES: You were eating in the same place I was at ten o'clock, Murray. It was good food too. No, your letter doesn't say that. I will find it.

MR. STEIN: All right, you will find that.

MR. JONES: I will find it after lunch.

MR. STEIN: All right.

I think we will adjourn for an hour and a half and reconvene at a quarter to two.

(Whereupon, at 12:20 p.m., the conference recessed until 1:45 p.m.)